ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

VOL. XLIII. No. 26.

TABLE OF CONTENTS.

ENGINEERING NEWS OF THE WEEK 417
Methods and Results of Surveys and Borings for Ogdensburgh Ship Canal Route (illustrated). 418
Difficulties Encountered in Building a Sewage Storage System at Concord, Mass. (illustrated)..... 422
Compound Duplex Locomotive for the McCloud River R. R. (illustrated) 423
Spreading Car, Boston & Maine R. R. (illustrated).. 427
The Maintenance of the Austin Dam After High Water (illustrated) 428
Annual Convention of the Master Car Builders' Association at Saratoga, N. Y. (illustrated)..... 428
Annual Convention of the American Railway Master Mechanics' Association 431
EDITORIAL NOTE 424
Proposed New Type of Vessels for Both Great Lakes and Coastwise Trade.
EDITORIAL 424
The Master Car Builders' and Master Mechanics' Conventions.
LETTERS TO THE EDITOR 425
First Impressions of the Paris Exposition—The Progressive Combustion of Gunpowder and Credit for Its Development.

WORK ON THE NEW YORK RAPID TRANSIT railway is now in progress in a number of places. On the tunnel proper work is being done at three points uptown. The removal of sewers, quite as important from an engineering point of view, is partially completed down town. The greatest activity for the next few months will take place on the Boulevard and Lenox Ave. Chief Engineer W. B. Parsons states that by September the work of excavating will be progressing at many places, from the upper end of the route clear down to Sixtieth St. Between 120th and 122d Sts. the work is being carried on rapidly from 120th St. toward 104th St. The roots of all the trees from 122d to 120th Sts. have been cut off close to the curb. McCabe & Brother, who have the subcontracts for the two northernmost sections of the western branch of the road, extending from 125th St. to the northern terminus, have begun work at two points between 133d and 138th Sts. and between 155th and 158th Sts. The work at 133d St. has been temporarily suspended, while some of the drawings for stone work were being prepared. Between 155th St. and 158th St. Contractor McCabe is drilling through rock, large forces of men being employed night and day. They are working from 155th St. north and from 158th St. south to a central point near 157th St. From 158th St. Mr. McCabe will work north. He has already obtained a permit to sink the shaft at 181st St., and this will be the next work he will undertake. Farrell & Hopper, who have the contract for the section on the eastern branch extending from the junction at 140th St. east under the park and up Lenox Ave. to 116th St., will begin work immediately. They have obtained a permit to work between 110th and 116th Sts., and their first excavation will be at 110th St. The relaying of sewers, which in some parts of the town is preliminary to any work on the tunnel itself, is progressing well. Work on three sewers is now being carried on. It will be commenced on another within a short time, and was completed on two this week. James Pilkington is now at work on the Oliver St. sewer, which is one mile long. It will not be finished for a considerable time. Cunningham & Kearns are working on the Mulberry and East Twenty-second St. sewers. At 110th St. there is a sewer which will soon be moved out of the way of the tunnel. The two completed sewers are those in Bleecker and Tenth Sts.

THE TRANS-SIBERIAN RAILWAY is reported upon in a pamphlet published under the direction of the Chancery of the Committee of Ministers on the Trans-Siberian Ry. According to this pamphlet the total length of line completed up to 1900 was 3,375 miles. This is an average of 375 miles of completed line per year since construction was begun, which is considered to be a very satisfactory record, considering, (1) the difficulty of laying the permanent way in a country so intersected by rivers as the provinces of Tomsk and Yenisei, and so liable to inundation as the Trans-Baikal region, and, (2) the great number of large rivers to be crossed by the railway, over 30 miles of bridges being required for this purpose. The longest of these bridges is that over the river Yenisei; it is 2,940 ft. long, with spans measuring 490 ft. In rapidity of construction the Siberian railway is unequalled and excels the Canadian Pacific Ry., 2,920 miles, with which it has so much in common, and which took ten years to build. When the navigation is open in 1900, there will be the possibility of direct steam communication between the European railway system and Vladivostok, partly by rail and partly by steamer, via the following route: From Tcheliabinsk to Sretensk by rail, 2,762 miles, crossing Lake Baikal, 40 miles, by means of an ice-breaking steamer, specially adapted for ferrying the whole train across; from Sretensk to Khabarofsk by steamer down the rivers Shilka and Amoor, 1,442 miles, and finally from Khabarofsk to Vladivostok again by rail, 478 miles. This journey will take about 2½ weeks. To facilitate travelling by the Siberian Railway, a special express service has been established between Moscow and Irkutsk, the trains starting every week. These trains have sleeping-cars, a dining-car, library, bath and gymnasium, and excel the best express trains of Europe in the comforts afforded to passengers. The journey from Paris or London to Vladivostok through Siberia now takes about 3½ weeks, while the journey by sea, via the Suez Canal, takes about six weeks. Communication will be still easier on the completion of the Circum-Baikal section, 157 miles, begun in 1899, as well as of Eastern Chinese or Manchurian line, 960 miles, with its southern branch of 653 miles now being constructed by the Russo-Chinese Banking Company. This line, begun in 1897, will join the Siberian line by the shortest route with Vladivostok and the open ports of the Lao-dun Peninsula, Port Arthur and Ta-lien-wan temporarily leased by Russia, with the land occupied by the Manchurian railway. When these two lines are completed, there will be direct railway communication between the Atlantic and Pacific Oceans, through Europe and Asia. The total length of the Siberian railway, with the Manchurian and other branches, will be 5,542 miles.

A CONCRETE MIXING PLANT, fed by a belt conveyor, has been installed at the new Waterside Station of the New York Gas & Electric Light, Heat & Power Co., at 38th St. and East River, in New York city. The contractors have set up a 5-ft. cubical mixer about 100 ft. from the river edge. On the old bulkhead platform a stone bin has been built, with measuring hoppers below it. Underneath these a 30-in. Robins Belt Conveyor runs, rising at an angle of 20° after it is clear of the platform and delivering into the mixer. A plain 9 x12-in. slide valve engine drives both the mixer and the belt. Four men are required to handle the stone, sand and cement, and the mixer is turning out concrete at the rate of 30 cu. yds. per hour. The plant is limited by the ability to distribute the concrete from the mixer, its full capacity under steady service being 60 cu. yds. per hour.

THE MOST SERIOUS RAILWAY ACCIDENT of the week was due to a wash-out near McDonough, Ga., on the Macon Branch of the Southern Ry., on June 23. A heavy rain had washed out a section of track nearly 100 ft. in length. A swiftly moving passenger train plunged into the gulf and, the wreck catching fire, the entire train, except the sleeper, was either consumed or carried away by the flood. Every person on the train, except the occupants of the Pullman car, perished. It is estimated that 40 persons in all were killed.——A passenger train on the Chicago & Northwestern R. R., loaded with excursionists, bound for Green Bay, Wis., collided with a freight train at De Pere, Wis., on June 24, killing eight persons and injuring 34. The freight train was being side-tracked when the accident occurred.

THE RAISING OF AN ENGINE SHAFT, weighing with its attachments 240 tons, is being accomplished by means of 15 screw jacks and an overhead crane at the powerhouse of the Metropolitan West Side Elevated Ry. in Chicago. The shaft belongs to one of the big engines operating the electric dynamos, and is being raised 36 ins. With steady pounding of a 74-ton fly-wheel the pillar blocks became loose and approached each other to the extent of 1-16-in. This caused the wheel to wobble. The object of the present operation is to put in new work that will make the engine's foundation stable.

A LIGHT STATION, on Hog Island Shoal, R. I., is to be let by contract on July 7, with proposals to be sent to the office of Lieut.-Col. D. P. Heap, U. S. Engineer Corps, the Light House Engineer of the 3d District, Tompkinsville, N. Y. The structure will consist of a circular foundation pier, 25 ft. diameter, surmounted by a three-story circular dwelling, topped with a circular lantern. The pier will be made of cast-iron filled with concrete in the lower part, sunk 24 ft. 4 ins. below high water, and 40 ft. high to top of cylinder. Rip-rap, 12½ ft. deep, will be deposited around the pier. The upper part of the cylinder will be lined with brick-work and brick cross-walls, and on these will be erected the cast-iron dwelling-house with three iron floors. Full detail drawings and specifications can be had by applying to Lieut.-Col. Heap.

A BRUSSELS-ANTWERP ELECTRIC RAILWAY is proposed, says U. S. Consul G. W. Roosevelt, of Brussels. The scheme is part of a project for building a network of electric lines, to supersede railways for all except freight traffic. The promoters propose a line of rails uninterrupted by crossings of any kind, and a run from one city to the other without stops. The distance is 27 miles, and a speed of 62 miles per hour is named in the bill; this would make the run in about 25 minutes. Trains every five minutes are talked of; and the rate of fare, which the government has a right to fix, is expected to be 25% less than the existing State railways. The bill now before the government provides for a concession of 60 years; at the expiration of which time the railway and its equipment becomes the gratuitous property of the government; and the State reserves the right to buy the road after ten years. The estimated cost of construction is $7,720,000. Transportation of all kinds of merchandise, including registered baggage, will be positively excluded.

CAISSON FOUNDATIONS FOR CHIMNIES and machinery have been successfully used at the power plant at the sewage disposal works at Asnieres, near Paris. The foundations for both the chimnies and the engines were sunk through a water-bearing soil by the use of compressed air. For the heavier machinery eight caissons were used, each 52 x 26.24 ft. in plan; two other caissons, 49.2 x 12.46 ft., were sunk for some of the smaller machinery, and for the chimnies two circular caissons were used, each 23 ft. in diameter. All of these caissons were sunk about 29.5 ft. below the water-level, and then filled with beton; with masonry directly under the machines. The material extracted amounted to 16,120 cu. yds., and the volume of the several caissons amounted to 14,065 cu. yds. The material was taken out of each caisson through a single central shaft, 3.4 ft. diameter, and an air-lock on top containing a hoist operated by compressed air. Five working months were consumed in sinking these foundations. The foundations under the walls of the plant were made by dropping a heavy conical weight from a pile-driver, and thus perforating the soil to a depth of about 23 ft. The holes thus made, without removing any material, were filled with concrete; their arrangement and distance apart are not referred to in the original article in "Le Genie Civil," from which the above note is taken.

THE CONTRACT FOR THE REMOVAL OF NIGHT-soil and stable manure in Paris was renewed, in July, 1899, at a price raised from $440,000 to $630,000. This augmention in cost has called out various plans for the treatment of stable manure, including that of burning. Mr. Paul Vaicey, departmental professor of agriculture, protests against the burning process, in the March bulletin of the "Societe Nationale d'Agriculture," as being unhealthy and wasteful of valuable fertilizing material. He proposes to collect this stable manure, at night, by means of wagons so constructed that they can run on the streets and also on the railways leading to the suburbs of Paris. He would remove this material between 12.30 midnight and 6 in the morning to depots provided, not less than 5 miles outside the walls of Paris, and there dispose of it to farmers.

THE SUPERIMPOSED TURRETS FOR BATTLESHIPS win, by the late decision of the special naval board, and they will be placed on the five new battleships lately authorized. Rear Admiral Bradford, of the previous board, appealed in a minority report favoring the new type of turret, and Secretary Long appointed a new board of 13 officers to reconsider the problem. While the detailed report is not yet made public, it is known that the "Kearsage" type was overwhelmingly approved by the board. While there is an admitted disadvantage in placing "too many eggs in one basket, by placing four guns in practically one turret, the great gain in arc of fire and concentration of fire seems to have counterbalanced this disadvantage.

NEW YORK CITY BRIDGES, under construction, have been reported upon by Bridge Commissioner John L. Shea, in his annual report for 1899. These include bridges over the Harlem River at 125th St. and First Ave., estimated contract price $1,036,191; over Spuyten Duyvil Creek, connecting Kingsbridge Road and Broadway, contract cost $53,607; over Harlem River at 145th St., contract cost $1,001,989; between Pelham Bay Park and City Island, cost $153,031. Progress is also reported on the proposed new bridge over the East River, and on bridges over Newtown Creek, in Brooklyn.

THE GROYNE-SYSTEM for stopping beach erosion is being successfully tried along the New England coast, at Provincetown and other points. These "groynes" are made by planting posts firmly in the sand, at right angles to the beach and extending from low to high water, and setting close planks from post to post. Their relative position prevents the force of the waves acting upon them injuriously, and the material intercepted by the planking rapidly forms a new beach and stops the erosive action.

STRUCTURAL STEEL PRICES have fallen to 1.90 cts. per pound in Pittsburg, or 2.05 cts. in New York, by an agreement of the manufacturers. This is a cut of about $7.00 per ton on the previous Pittsburg price; and companies represented in the agreement included the Carnegie Steel Co., Jones & Laughlin, the Pencoyd Iron Works of Philadelphia, the Passaic Rolling Mills, the Cambria Iron Co. and the Phoenix Steel Co. It is expected that the reduction will stimulate the building trade, which has fallen off in the last year owing to the high price of materials.

METHODS AND RESULTS OF SURVEYS AND BORINGS FOR OSWEGO-MOHAWK SHIP CANAL ROUTE FOR U. S. BOARD OF ENGINEERS ON DEEP WATERWAYS.

By D. J. Howell.*

II.

Stadia Work.

As the success, speed and economy of stadia work so largely depends upon the stadia rodmen employed, and a display of good judgment in the quick and systematic selection of characteristic points, and a comprehensive appreciation of the value of these points, at which readings are given, in comparison with the scale upon which the work is to be plotted and the purposes for which the work is to be utilized, an effort was made in the selection of these rodmen, as indeed of all assistants where special experience in the class of work required was not obtainable, to obtain men of at least technical training. The assumption was that such assistants could more quickly be trained intelligently to perform the duties required of them. While this is undoubtedly true, as a general proposition, at the same time the author has employed men without the benefit of a technical education, but richly endowed with that most indispensable requisite, good common sense and judgment, who make the most useful assistants in field and office. Other members of the profession have doubtless had the same experience.

It has been and doubtless still is advocated, that with a liberal amount of characteristic contour points taken over the area to be mapped, and the location of shots made of natural and artificial features, a sketch is practically useless, and the time and labor involved in making the same is largely wasted. Such an argument, it is believed, will not be found practicable in actual practice if a comparison is made between the results of the survey when plotted and drawn, and the conditions on the ground.

The author is convinced that an indispensable requisite to a correct representation as far as possible of the topographic features of a locality, when plotted and drawn in the office, is a full, clear and complete sketch, made on the ground at the time of the survey, not necessarily to any fixed scale, but with the relative positions of the shots taken, as indicated by numbers corresponding with those of the recorder, and the positions of these numbers with reference to the features and contours sketched. Whether the notes as taken in the field are drawn by the party or parties who took them, which is believed to be the best practice, when practicable, or by others unfamiliar with the location and conditions, the sketch, however crude it may be, is of inestimable value, its accuracy and clearness, however, largely increasing its usefulness.

It is a transmission to paper and a vivid future reminder of the impressions of the shape of the ground and its features as made on the mind of the observer with these spread out before him, and is of great value as a check on the accuracy of the readings for direction, distance and elevation. It enables those not engaged on the field work and unfamiliar with the section more accurately and quickly to draw the maps.

In actual practice the author has found two intelligent persons with the same data before each and in the absence of sketches, misrepresent to a marked degree of difference the facts as they existed on the ground.

The most satisfactory results on this division were obtained under the following organization of a stadia party; one in charge, one observer, one recorder, and four stadia rodmen. The instrumentman in charge did most of the sketching, and generally directed the party in the prosecution of the work. He was at full liberty to remain at the instrument or to follow the rodmen where he deemed best to more accurately sketch at close range. He identified his sketch with the recorder's notes, by using similar numbers for shots taken, checking up these numbers with him at intervals of each 10 or 20 shots. The observer ran the instrument and took all observations, having a code of signals for each rodman. The recorder recorded the readings as called out to him by the observer, noting also the character of the shot taken, whether a contour point (C. P.), a fence corner (f. c.), stream (str.), ditch, top of bank (T. B.), water edge (W. E.), corner of building (C. Bld.), etc., an index of the abbreviations used being recorded in the back of each note book with the index of [illegible] found in the book. In this connection [illegible] demonstrated that even with a rapid [illegible] time was wholly occupied in the mere [illegible] of readings as called out by the obser[illegible] three good rodmen were employed, an[illegible] was available for the making of sketch[illegible] recorder, and furthermore, sketches, if [illegible] him, with the rodman at long range, w[illegible] tend to mislead rather than aid. Thr[illegible] were generally employed with each sta[illegible] and a fourth one when occasion requir[illegible]

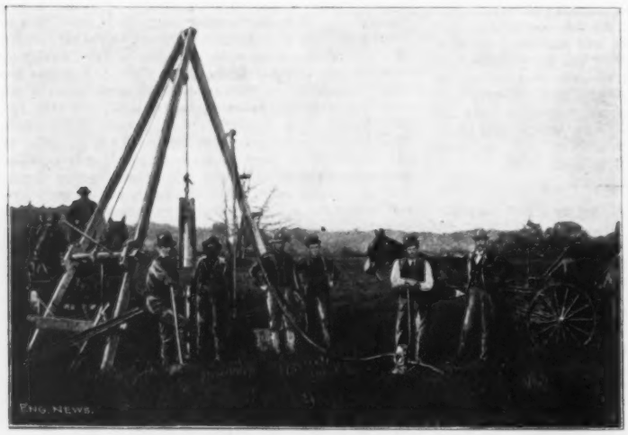
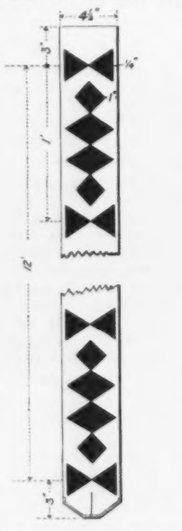


FIG. 5.—TRIPOD BORING MACHINE, OSWEGO-MOHAWK SHIP CANAL SURVEY.

FIG. 6.—PILE-DRIVER BORING MACHINE OSWEGO-MOHAWK SHIP CANAL SURVEY.



Front View of Stadia Rod
Scale

Fig. 2.—Front View of Standard Stadia Rod, Oswego-Mohawk Ship Canal Survey.

rodmen each kept a record of the number of his shots corresponding with those of the recorder, and distinguished by an initial letter, generally of his name. By this means he could at any time call out the same to the head of the party doing the sketching. These numbers, representing the shot taken, were started with number one (1) for each day's work; their sole object being the identification at all times of the recorder's notes with the sketches or notes of the rodmen, or the one doing the sketching. Each rodman briefly and quickly noted while holding his rod, either in a note-book or more generally on a slip of paper tacked on the back of his rod the number of his shot and the character of the shot, whether a contour point, fence corner, etc. If covering a section inaccessible to or far removed from the one doing the sketching, the rodman made a sketch joining the shots taken. At the noon hour, or after the day's work was over, in a brief space of time the rodmen's notes were checked with those of the recorder, and any omissions in the recorder's notes supplied and entered in his book when the usefulness of the slips of paper used by the rodmen ended. The fourth rodman, when not needed in the field, was employed at the temporary headquarters of the party in the reduction and plotting of field notes.

The mounted map sheets upon which the work was plotted, were sent to the stadia parties from the Assistant Engineer's office with the transit line plotted thereon by co-ordinates, and, also, the co-ordinates drawn. These sheets when not in use, were kept in map cases, provided for the purpose. The stadia parties used the same system of co-ordinates as a basis of all their stadia circuits.

On days unfit for field work, the members of the party were engaged at their temporary headquarters in the reduction of notes and plotting all shots taken in pencil only, and the drawing in of all natural and artificial features.

By this method this important part of the office work was kept well up with the field work, and any corrections found necessary or additional data needed could be supplied before the party removed to any great distance from the work. As fast as the sheets were completed they were sent in to the office of the Assistant Engineer, when a convenient opportunity offered. While the author believes it is a preferable plan to have this portion of the office work kept up, as stated by the parties in the field, when possible, in preference to having the notes only reduced in the field office

*State of New York Canal Survey, Albany, N. Y.

and the ... sent in to the Assistant Engineer's office to be ... ted and drawn in by men there; at the same time it is appreciated that under certain conditions this last-mentioned plan might be preferable.

In other words, methods for the accomplishment of certain ... perhaps, well adapted to one locality and ... meet certain conditions, may be, and in fact, ... only are, largely useless in other cases.

The stadia parties employed on this division were designated by a letter of the alphabet, "A" or "B" or "C," ... The instrument stations of each party were started with No. 1, and carried by consecutive numbers through the entire work. Stakes at instrument stations were marked with the number of the station and the letter designating the party. This caused no confusion in numbers and in the stakes of each party when working in close proximity or when the work of one party was connected with that of another.

The notes of the main stadia circuits were reduced from printed tables furnished. All minor circuits and all side readings were reduced by diagrams. The value of the divisions between stadia wires in each instrument was determined by careful readings between targets of a level rod over a carefully-measured distance of 1,000 ft., readings being taken at each 100 ft. The stadia rods were divided in accordance with these determined values and painted accordingly.

The stadia rods (Fig. 2) used were made of straight grain white pine, free from knots, and planed down smooth throughout with the corners slightly rounded. A brace about 11½ ft. long was screwed on the back. This brace was slightly beveled at each end, and about 1¼ ins. thick by ¾-in. wide. An iron shoe about 1-16-in. thick was screwed to the bottom of the rod. An iron plate 4 ins. × 2 ins. × 1-16-in. was screwed on the back of the rod at the top and bottom to strengthen the same. The rods were 12½ ft. long × 4½ ins. wide × ½-in. thick. They were given two coats of white paint before being marked off into feet and tenths. The first foot was 3 ins. from the bottom, and the twelfth foot 3 ins. from the top. They were painted as shown in the drawing. The diamonds at the fifth and tenth feet were painted red, the others black. Figures designating the feet were also painted on some of the rods, and it was found an aid to quick reading. A number was painted on the back of the rod corresponding to the number of the instrument for which it was graduated. The diamonds should be first penciled and then ruled with a right-line pen filled with paint and filled in with a small camel's hair brush. This work should be done by some of the assistants in the office and the rod allowed to dry thoroughly before using. The cost of these rods ready for painting did not exceed $1.20 each.

Some changes were made in the painting of these rods to suit certain observers, whose impression it was that more accurate and quicker readings could be made with the changes suggested by them.

TABLE II.—Comparison of Stadia and Base Line Work Deduced from the Relocation by Stadia of the Base Line for a Distance of 5.6 Miles.

Station as per Transit line.	Station as per Stadia line.	Error in distance of stadia line, + or —.	Azimuth by Transit line.	Azimuth by Stadia line.	Elevation by Level.	Elevation by Stadia.	Error of stadia levels, + or —.
162 + 37.89 ft.							
165 + 56.68 "	165 + 56.7 ft.	0.0 ft.	98° 16′ 00″	98° 16′ 00″	95.10 ft.	95.10 ft.	0.00 ft.
168 + 87.92 "	168 + 89.1 "	+ 1.2 "	108° 34′ 00″	108° 35′ 15″	98.42 "	98.38 "	— 0.04 "
173 + 26.90 "	173 + 26.3 "	— 0.3 "	107° 10′ 00″	107° 11′ 15″	90.32 "	90.31 "	— 0.01 "
182 + 37.06 "	182 + 36.6 "	— 0.8 "	158° 39′ 30″	158° 40′ 15″	104.95 "	104.99 "	+ 0.04 "
185 + 77.10 "	185 + 76.2 "	— 0.9 "	128° 12′ 00″	128° 12′ 00″	123.86 "	123.87 "	+ 0.01 "
189 + 53.40 "	189 + 51.7 "	— 1.7 "	155° 52′ 30″	155° 52′ 15″	136.52 "	136.60 "	+ 0.08 "
200 + 29.18 "	200 + 25.6 "	— 3.6 "	140° 50′ 30″	140° 50′ 00″	142.70 "	142.84 "	+ 0.14 "
207 + 88.34 "	207 + 84.9 "	— 3.4 "	139° 11′ 00″	139° 10′ 30″	165.41 "	165.64 "	+ 0.23 "
211 + 64.40 "	211 + 60.1 "	— 4.3 "	123° 12′ 30″	123° 12′ 00″	155.63 "	155.84 "	+ 0.21 "
217 + 74.67 "	217 + 70.7 "	— 4.0 "	150° 03′ 30″	150° 03′ 30″	154.73 "	154.82 "	+ 0.09 "
224 + 08.30 "	224 + 03.2 "	— 5.1 "	153° 43′ 30″	153° 43′ 30″	164.44 "	164.52 "	+ 0.08 "
224 + 80.99 "	224 + 75.7 "	— 5.3 "	[1]142° 13′ 00″	142° 09′ 45″			
226 + 66.60 "	226 + 62.8 "	— 3.8 "	[2]186° 58′ 00″	186° 56′ 00″	154.56 "	154.57 "	+ 0.01 "
230 + 17.29 "	230 + 13.8 "	— 3.5 "	174° 47′ 30″	174° 46′ 30″	154.37 "	154.32 "	— 0.05 "
236 + 52.67 "	236 + 47.4 "	— 5.3 "	161° 46′ 30″	161° 45′ 15″	154.86 "	154.69 "	— 0.17 "
243 + 06.16 "	243 + 00.9 "	— 5.3 "	170° 13′ 30″	170° 12′ 00″	156.02 "	155.78 "	— 0.24 "
253 + 34.99 "	253 + 22.0 "	— 13.0 "	150° 18′ 30″	150° 16′ 45″	155.95 "	155.78 "	— 0.17 "
257 + 58.35 "	257 + 47.6 "	— 10.7 "	120° 39′ 30″	120° 37′ 15″	190.21 "	190.23 "	+ 0.02 "
267 + 13.73 "	267 + 00.7 "	— 13.0 "	159° 20′ 00″	159° 17′ 30″	191.85 "	191.69 "	— 0.16 "
270 + 06.33 "	269 + 92.2 "	— 14.1 "	139° 25′ 30″	139° 23′ 15″	192.86 "	192.31 "	— 0.55 "
276 + 16.07 "	276 + 01.7 "	— 14.4 "	120° 31′ 00″	120° 29′ 00″	190.99 "	190.90 "	— 0.09 "
284 + 41.93 "	284 + 29.1 "	— 12.8 "	146° 01′ 30″	145° 59′ 30″	190.68 "	190.67 "	— 0.01 "
289 + 68.83 "	289 + 57.9 "	— 10.9 "	163° 59′ 30″	163° 58′ 15″	190.39 "	190.57 "	+ 0.12 "
292 + 65.18 "	292 + 54.4 "	— 10.8 "	136° 31′ 00″	136° 30′ 30″	190.33 "	190.26 "	— 0.07 "
297 + 69.65 "	297 + 60.2 "	— 9.4 "	125° 35′ 30″	125° 34′ 45″	190.31 "	190.11 "	— 0.20 "
301 + 99.41 "	301 + 90.7 "	— 6.7 "	152° 07′ 00″	152° 06′ 15″	191.28 "	191.08 "	— 0.20 "
313 + 10.28 "	313 + 03.7 "	— 8.6 "	183° 00′ 30″	182° 59′ 45″	191.22 "	191.25 "	+ 0.03 "
322 + 57.21 "	322 + 50.9 "	— 6.3 "	178° 44′ 00″	178° 43′ 00″	191.46 "	191.58 "	+ 0.12 "
326 + 71.22 "	326 + 63.4 "	— 7.8 "	165° 37′ 00″	165° 36′ 00″	189.85 "	190.02 "	+ 0.17 "
332 + 94.44 "	331 + 94.9 "	— 9.5 "	144° 31′ 00″	144° 29′ 45″	191.81 "	191.95 "	+ 0.14 "
342 + 11.26 "	342 + 00.0 "	— 11.3 "	137° 27′ 00″	137° 25′ 00″	189.74 "	189.79 "	+ 0.05 "
345 + 84.25 "	345 + 72.1 "	— 12.2 "	172° 32′ 30″	172° 30′ 30″	190.60 "	190.59 "	— 0.01 "
356 + 46.47 "	356 + 32.6 "	— 13.9 "	179° 05′ 30″	179° 03′ 00″	192.10 "	192.07 "	— 0.03 "
361 + 80.69 "	361 + 66.3 "	— 13.4 "	163° 35′ 30″	163° 32′ 45″	195.65 "	195.75 "	+ 0.10 "
366 + 33.37 "	366 + 17.8 "	— 15.6 "	63° 57′ 00″	63° 54′ 15″	183.60 "	183.74 "	+ 0.14 "
373 + 32.27 "	373 + 17.4 "	— 14.7 "	78° 49′ 30″	78° 46′ 45″	178.56 "	178.50 "	— 0.06 "
378 + 32.63 "	378 + 17.5 "	— 15.1 "	85° 52′ 30″	85° 49′ 30″	183.49 "	183.56 "	+ 0.07 "
388 + 44.34 "	388 + 31.5 "	— 12.8 "	31° 36′ 30″	31° 33′ 30″	192.53 "	192.79 "	+ 0.26 "
392 + 82.07 "	392 + 68.8 "	— 13.3 "	26° 35′ 30″	26° 32′ 15″	181.46 "	181.72 "	+ 0.26 "
404 + 77.12 "	404 + 65.1 "	— 12.0 "	15° 01′ 00″	14° 58′ 00″	175.74 "	176.09 "	+ 0.35 "
410 + 88.65 "	410 + 75.8 "	— 12.8 "	352° 04′ 00″	352° 01′ 00″	179.17 "	179.46 "	+ 0.29 "
423 + 62.13 "	423 + 47.5 "	— 14.6 "	28° 49′ 30″	28° 46′ 45″	180.20 "	180.50 "	+ 0.30 "
427 + 47.82 "	427 + 32.3 "	— 15.5 "	38° 18′ 30″	38° 15′ 45″	186.70 "	187.11 "	+ 0.41 "
431 + 88.25 "	431 + 72.0 "	— 16.2 "	30° 36′ 30″	30° 34′ 15″	178.26 "	178.54 "	+ 0.28 "
437 + 69.49 "	437 + 52.3 "	— 17.2 "	44° 42′ 00″	44° 40′ 15″	177.05 "	177.36 "	+ 0.31 "
441 + 89.92 "	441 + 72.6 "	— 17.3 "	46° 49′ 00″	46° 47′ 30″	193.62 "	193.96 "	+ 0.34 "
445 + 82.97 "	445 + 65.3 "	— 17.7 "	37° 56′ 30″	37° 55′ 45″	215.91 "	216.22 "	+ 0.31 "
448 + 65.65 "	448 + 47.6 "	— 18.0 "	43° 53′ 30″	43° 53′ 15″	190.60 "	190.95 "	+ 0.35 "
454 + 17.49 "	453 + 98.7 "	— 18.8 "	14° 02′ 00″	14° 02′ 30″	187.29 "	187.67 "	+ 0.38 "
458 + 17.33 "	457 + 98.4 "	— 18.9 "	15° 22′ 15″	15° 23′ 15″	178.57 "	179.06 "	+ 0.49 "

[1]Azimuth start together again from here. [2]These azimuths are cut out from the base line. [3]Difference here is due to the base line point being on a snubbing post. H. I. estimated.

FIG. 7.—APPARATUS MOUNTED ON A CATAMARAN FOR RIVER BORINGS, OSWEGO-MOHAWK SHIP CANAL SURVEY.

FIG. 8.—VIEW SHOWING METHOD OF DRAWING THE CASING IN MAKING BORINGS, OSWEGO-MOHAWK SHIP CANAL SURVEY.

While the rod as shown may be subject to criticism by some as being too light in construction to be serviceable, it will at least not be criticised on this score by the rodman, who carries it all day, and it is the opinion of the author that their cheapness would justify the making of a few extra ones, rather than expend the energy of an ambitious and active rodman in carrying a load of useless lumber.

There are those, generally speaking, who have never used, to any great extent, improved stadia methods, who seriously question the accuracy of the same to the extent of its usefulness for surveys of this nature and general preliminary surveys.

It is believed a thorough appreciation of the excellent results attainable with properly-graduated rods and ordinary refined methods would lead to its more general adoption, and enable preliminary surveys and examinations for contemplated works to be made at a large saving of time and expense. It is with a view to this that the following results of stadia work, as found on this division, are given. Equally as good results were obtained, the author is informed, on other divisions of the survey.

In the early stages of this work, when the organization was being perfected and the parties trained to the adoption of the best methods for the prevention and elimination of errors, more likely to occur at the beginning of surveys of such an extended nature, the transit line as measured by steel tape and leveled with Y-level was retraced with a stadia line, each transit station being occupied, and a forward and back reading being taken in each case for distance and vertical angle, the mean of the two being taken as the correct result.

These distances and elevations, as obtained by stadia, were carried continuously over the distance given, and offer an interesting and instructive lesson, by direct comparison, as to the excellence attainable by stadia methods, compared with careful transit work, with steel tape, and Y-levels. About one-half of this line was along the tow path of the Erie Canal, and the other half across

country. The work was done in the month of December. I do not believe quite as favorable results could be depended upon if the weather was warm and the air "boiling." The table of comparison follows:

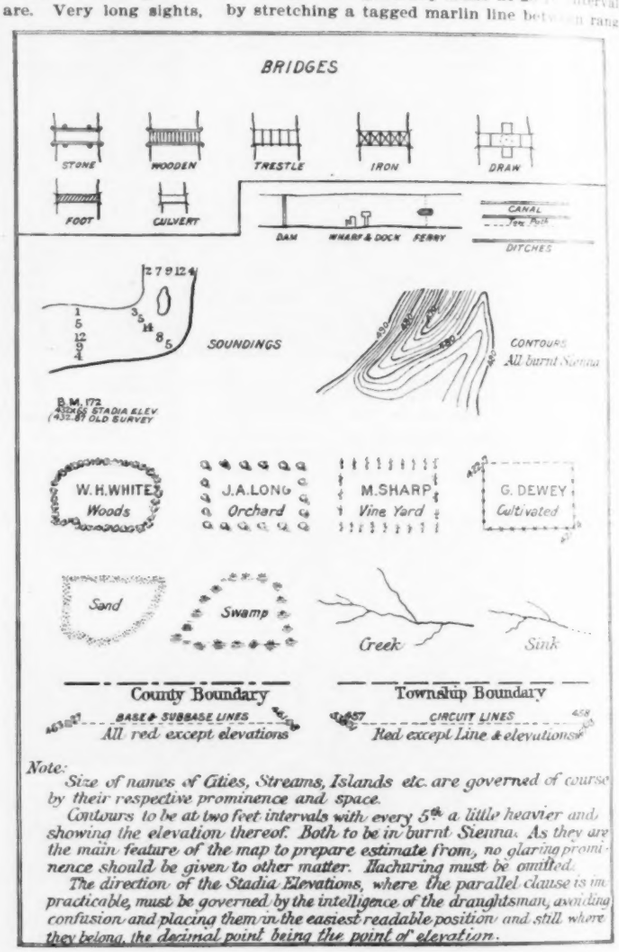
A number of stadia circuits were run during the progress of the work along the entire line under many varying conditions as to temperature, wind and character of ground passed over. To attempt to give a complete list of them, with the varying conditions under which they were run, would consume more time and space than the object in view would justify.

Some of these circuits of various lengths began with and closed back on transit or stadia stations, others beginning with and closing on stadia stations of previous circuits. The general results following are selected at random as samples of the work of this kind.

The above are results of average work under usual conditions met with, and can be duplicated under the same conditions. Results largely in excess of these, as to accuracy of distance were accomplished but are not given here as they are not considered fair averages of what can be accomplished. The error in the circuit as given is found by dividing the length of the hypothenuse of a right angled triangle, as obtained from the closing error in latitude and departure, into the length of the stadia portion of the circuit, the length of the transit line, if any, not being included in the length of the circuit.

In stadia work it will be found many observers have a "personal error"; that is, a tendency to read all distances either somewhat longer or shorter than they really are. Very long sights, brush, necessitating the moving of th... range line down stream (and soundings should ... ways be taken down stream if possible) by ... on each side instead of walking down the bar... with the line. The instrumentman or record... ther recorded the soundings as called out b... e leadsman, or directed the lining in of th... sounding boat from shore or the moving of th... ine after each range of sounding to the next r...

Range stakes for soundings were ... on the banks of the river either by the stadi... arties or by the sounding party in advance of ... sounding. These range stakes were genera... at about 300 ft. intervals, unless irregularities ... ne river bottom necessitated intermediate ra... s. The soundings were generally made at 20 ... intervals by stretching a tagged marlin line bet... n range


BRIDGES
STONE
WOODEN
TRESTLE
IRON
DRAW
FOOT
CULVERT
DAM
WHARF & DOCK
FERRY
CANAL
DITCHES
SOUNDINGS
CONTOURS
All burnt Sienna
W. H. WHITE
Woods
J. A. LONG
Orchard
M. SHARP
Vine Yard
G. DEWEY
Cultivated
Sand
Swamp
Creek
Sink
County Boundary
Township Boundary
BASE & SUBBASE LINES
All red except elevations
CIRCUIT LINES
Red except Line & elevations
Note:
Size of names of Cities, Streams, Islands etc. are governed of course by their respective prominence and space.
Contours to be at two feet intervals with every 5th a little heavier and showing the elevation thereof. Both to be in burnt Sienna. As they are the main feature of the map to prepare estimate from, no glaring prominence should be given to other matter. Hachuring must be omitted.
The direction of the Stadia Elevations, where the parallel clause is impracticable, must be governed by the intelligence of the draughtsman, avoiding confusion and placing them in the easiest readable position and still where they belong, the decimal point being the point of elevation.

FIGS. 3 AND 4.—CONVENTIONAL SIGNS FOR MAPS OF OSWEGO-MOHAWK SHIP CANAL SURVEY.

Sixteen circuits as run by one of the stadia parties during the period from May to October, 1898, gave the following results:

Average length of circuits	12,366 ft.
" number of stations occupied	17
" running error in azimuth	1′ 49″
" error in elevation	0.20 "
" " " circuit	1,783 "
Maximum error in circuit	1 in., 700 "
Minimum error in circuit	1 in., 3,400 "

Thirty-five circuits as run by another stadia party between October, 1897, and April, 1898, show:

Average length of circuits	5,356 ft.
" number of stations occupied	11
" running error in azimuth	1′ 32″
" error in elevation	0.47 "
" " circuit	1,408 "
Maximum error in circuit	1 in., 801 "
Minimum error in circuit	1 in., 4,096 "

Forty-four circuits as run between April and July, 1898, show:

Average length of circuits	7,384 ft.
" number of stations occupied	12
" running error in azimuth	1′ 32″ "
" error in elevation	0.35 "
" " circuit	1,832 "
Maximum error in circuit	1 in., 700 "
Minimum error in circuit	1 in., 4,244 "

The width of the Mohawk River along which soundings were made varied in width from 300 to 1,000 ft. The depth at medium stage varied from a few feet to 20 and 30 ft., with some short stretches of greater depth. The current was at times swift with riffs in places.

A sounding party under ordinary conditions consisted of one instrumentman, one recorder, one leadsman, three oarsmen. When this party was engaged in setting range stakes, a copy of the transit line azimuths and Y-level elevations of transit hubs was furnished them and the lines as run were started from the transit line and tied into the same at from one to three mile distances. The oarsmen and leadsman acted as stadia rodmen and axemen.

When engaged in taking soundings two boats were generally employed to advantage, especially if the river banks were overgrown with underwork done when the air is "boiling" or during high wind, or lines run over areas in which high vertical angles occur, all tend to decrease the accuracy of stadia work, but as all these conditions are met with the results given embody them.

Soundings.

stakes. Cedar floats were attached at about 50 ft. intervals to buoy up the line and aid in moving the same. If the water did not exceed about 12 ft. in depth a rod with an iron shoe on the bottom was used for soundings, a tagged line attached to a lead being used for greater depths. The character of the river bottom as far as the same could be judged of by the leadsman in sounding was noted by the recorder. The elevation of water surface was noted from reading of established gages or determined from the range stakes, the elevation of which were determined. Where the width of river was from 800 to 1,000 ft. a line could not be advantageously used and either time soundings, cut in at intervals with an instrument on shore were made, or locations by intersections. During the winter months when the river was frozen soundings were made through holes cut in the ice with ice bars at measured intervals on ranges.

Office Work in Assistant Engineer's Office.

The office of the Assistant Engineer was located at such points along the line as proved convenient and accessible to the several field parties.

In this office such a force of draftsmen and

computers employed as were from time to time needed. The mounted sheets upon which the final maps were to be drawn were furnished from the office of the U. S. Board of Engineers on Deep Waterways. As the co-ordinates of transit stations as computed by the transit party in the field from corrected notes, with lengths and distances were sent in to the Assistant Engineer's office and there carefully plotted on the map sheets and the co-ordinates drawn, which they were sent out to the stadia parties. When the notes of the stadia party were plotted on these sheets in pencil they were returned to the Assistant Engineer's office, where they were checked, with the borings and soundings and all data was checked.

They were then contoured in pencil, carefully looked over by the head of the stadia party and by the chief draftsman, after they were inked to see that all data in the note-books had been transferred to the map, when they were sent to the office of the U. S. Board of Engineers in Detroit complete, except the inking of titles.

The sheets were numbered consecutively. On each sheet was given the name of the route, the scale of the work, the origin of co-ordinates upon which the system was based, and a list of the numbers of each note-book which contained any notes on that sheet.

Sheets of conventional signs as issued by the U. S. Board of Engineers on Deep Waterways is shown by Figs. 3 and 4 as illustrating the size of the map sheets used, the method of marking stakes on the ground and the conventionals used on the maps. The scale of all maps on this division was 1 in 2,500, except the sheets embracing the line of canal through Little Falls, N. Y., where the scale was 1 in 1,000 on account of the large amount of detail to be shown and the fact that this section was all rock and the topography very broken.

Area Mapped and Cost per Acre.

The area mapped along the Mohawk valley from the Hudson River westward to Herkimer, N. Y., a distance of about 90 miles, embraced some 47,400 acres. In this area is embraced some 6,600 acres of river. The average cost per acre for the total number of acres mapped was about 86 cts. This price, which is exclusive of the cost for borings, embraced all expenses incident to organization the purchase of instruments and supplies, all transit line; duplicate levels, stadia work and soundings, all office computations, and the drawing of the final maps on the map sheets with contours at 2-ft. intervals. In brief, the completed maps, except the inking of titles, ready for the projecting of a located line and the making of estimates. All maps were drawn to a scale of 1 in 2,500, except the section through Little Falls, N. Y., where the scale was 1 in 1,000.

A large amount of detail was embraced within the area, especially at the cities, towns and villages along the line, and the scale used, while necessitating somewhat greater cost, was deemed necessary to represent properly the details taken and utilize to their full value the results of the surveys as made.

A cross-country survey of some 25 miles in length, and embracing some 7,600 acres, cost, exclusive of instruments and the cost of borings, but including all field work and reduction of notes ready for plotting the same on the map sheets, about 27 cts. per acre.

The cost of the completed maps in this case was not kept, but it is believed it would not have exceeded an additional 23 cts. per acre, or about 50 cts. per acre as a total.

The difference in cost in the two cases was due mainly to the fact that the last survey was made largely by those whose training and experience in the class of work required had extended over a period of about one year, and also to the fact less detail existed to be taken. The limits of the survey could in many cases be covered without circuits being run from the transit line and over a large portion of the area, the taking of less detail was permissible, being without the limits of the actual canal location. The weather also was exceptionally favorable.

So many varying conditions affect the cost of such surveys, that a comparison of the cost in any one case with that of another is extremely difficult and very uncertain to make. There is ample latitude for conscientious work going unrewarded in a lack of opportunity occurring to form a just appreciation of the value of services rendered and the care and pains expended.

Borings.

For the first borings made on this division a "Pierce Well Boring Machine" was used, for a description of which reference is made to the maker's catalogue. It is a compactly-built machine, and rendered very effective service. Three other styles of machines were used which were built on the work. Their construction was for the most part of wood, easily and cheaply built, and they gave very satisfactory service. One of these machines is shown in Fig. 5. It is a simple tripod, with a pulley at the top, over wihch a rope is passed, to one end of which either a large wooden maul is attached for driving the casing pipe or the drill rods for washing out the sample of the material inside the pipe. With the other end of the rope one or two men raise and lower the maul or drill rods, through which water was forced from a pump near by. This machine was not as well adapted to penetrating hard material as the style shown in Fig. 6.

This machine was constructed on the plan of a small pile driver. The base was about 4 ft. between the foot of the leads and the brace, and extended out about 2½ ft. in front of the lead. The height was about 15 ft., with the leads protected by thin strips of iron in which an iron hammer weighing from 160 to 180 lbs. with a hollow in which a wooden cushion was set was raised and lowered by means of a rope passing over an 8-in. pulley at the top.

The hammer was used for driving the casing. A projection at the top of the machine held another pulley over which a rope was drawn and attached to hollow drill rods. When the casing was being washed out the machine was thrown back about 18 ins. with a bar when drilling was in progress.

Either machine can be easily and quickly loaded with the tools into a wagon and moved from place to place. This machine was well adapted to the penetration of hard material and the putting down of deep holes.

Fig. 7 shows the method of making borings in the river using a catamaran. The Pierce machine rigged on a catamaran was also used for river boring. The pile driver machine is not so well adapted to this class of borings on account of the lack of space to guy it.

Fig. 8 shows the usual method used for drawing the casing. Screw jacks were used when the casing could not be drawn with the lever and chain. The casing used was 2½ ins. in diameter, extra heavy in lengths of 2½ and 5 ft., joined with couplings. Hollow drill rods ¾-in. in diameter in 5 and 10 ft. lengths were generally used. Solid steel drill rods, with male and female screw 1¼ ins. in diameter and in lengths of 10 ft. were used for penetrating rock.

Hydraulic x-bits or 2-in. flat pointed bits attached to the drill rods were used. Douglass or Gould force pumps were used for forcing water from streams near by or from barrels filled with water through the hollow drill rods as they were churned up and down to the bottom of the casing. The overflow was caught in buckets and the material after settlement preserved in wide mouth 4 oz. bottles. A sample was taken at each change of material. Where a dry sample was desired a hollow rod was forced down in the casing and the core preserved.

On labels pasted on the bottles were recorded the elevation of the surface of the ground at the boring and the elevation at each change of material. Blasting was resorted to where boulders or cemented material that could not be drilled through obstructed the casing. This was done by raising the casing 3 or 4 ft., dropping down one or more sticks of dynamite and firing with a battery.

In severe freezing weather portable houses, about 8×12 ft., were used with each machine in which a portable stove was placed to heat water for use in the borings. In a number of cases the machine and entire outfit had to be moved by hand when the location of the boring was inaccessible to teams. For about one month during the latter part of the work two Sullivan boring outfits were used, being transferred from another division of the work.

The machine proper was a simple tripod somewhat similar to that shown in Fig. 5, with the addition of two wagon wheels attached to the ends of a drum. These wheels served the double purpose of being used both for raising the casing by means of a rope passing over a pulley at the top of the machine and being wound on the drum, and also for moving the machine by attaching it to the back of a wagon or hauling it by hand. In using this machine the casing was not driven. Flush joint casing 2½ ins. in diameter was used, and was worked down by a constant twisting of the same with pipe tongues, and at the same time the churning up and down of a hollow drill rod 1⅞ ins. in diameter, through which a stream of water was constantly forced from a pump.

Explosives were freely used to remove any obstructions to the casing pipe. A decided advantage in this method is the keeping of the casing constantly loose and the ease with which it can be drawn when the boring is completed.

The organization of the boring division consisted of one superintendent of borings, reporting to the Assistant Engineer. Each boring party was in charge of a foreman, who also assisted in the work, and from three to four laborers. These separate parties reporting to and receiving instructions from the superintendent.

No just comparison can be made between the results obtained from the several machines working as they were under many varying conditions as to surroundings and character of material encountered, depth of holes and frequent moves; nor can the results of progress made and cost of work on any one division of a large survey be taken as a criterion for others. Table III. of the results of borings on this division may, however, be of interest. The borings varied in depth from a few feet to depths of from 100 to 190 ft. The price per foot includes all items of cost, including plant.

TABLE III.—Showing Number of Borings Made, Character of Material Penetrated with Total Penetration and Average Cost per Foot.

	Soundings by hand with st'l rod in Mohawk River.	Test borings with machine, Mohawk Valley. On land and river.	Test borings with machine, Mohawk Valley. Cross-country lines & add'l borings.	Grand total.
No. land borings...	.....	804	271	1,165
No. river borings..	.....	397	...	397
No. soundings	290	...	...	290
Earth	...	7,139	472	7,611
Sand	53	17,097	3,556	20,706
Clay	36	3,762	6,082	9,880
Blue clay	...	...	177	177
Gravel	118	2,678	19	2,815
Shale	...	44	117	161
Hard-pan	...	40	60	100
Quicksand	...	664	865	1,529
Sand and gravel...	290	1,637	801	2,728
Sand and clay	...	726	2,450	3,176
Clay and gravel ...	...	...	760	760
Sand and shale ...	...	35	227	262
Clay and shale	...	900	2	902
Gravel and stone ..	...	...	105	105
Gravel and boulder	...	...	177	177
Hard-pan & bould'r	...	...	87	87
Hard-pan and stone	...	...	36	36
Sand and cobble...	...	...	63	63
Gravel and shale..	...	292	...	292
Sand, gravel, stone	...	22	55	77
Sand, loam, mud..	173	727	...	900
Sand, clay, gravel.	...	1,843	...	1,843
Gravel and cobble.	...	33	58	91
Mud	417	...	...	417
Rock	...	413	213	626
Total penetration.	1,087	38,052	16,382	55,521

Average penetration of 290 soundings in Mohawk River (exclusive of depth of water), 3.7 ft.

Average penetration of 1,291 borings in Mohawk Valley, 29.5 ft.

Average penetration 271 borings on cross-country lines and for dam and lock sites, 60.4 ft.

Average penetration of 1,562 borings, total on all lines, 34.8 ft.

Average cost of 55,521 lin. ft., total penetration of all borings and soundings, $0.54 per ft.

Office Work in Detroit Office.

Upon the completion of the map sheets the first work was the projecting of a center line of location by the U. S. Board of Engineers and the authorizing of the plotting of a profile on which was shown the character of the material along the line as indicated by the borings. The plotting of cross-sections was then proceeded with and the making of estimates therefrom and other computations incident to a work of such magnitude and which will doubtless be fully discussed in the final report of the U. S. Board of Engineers on

Deep Waterways to be submitted to Congress at an early date.

Restrictions are in many cases thrown around an engineer which so frequently not only retard the progress of his work, but also so materially affect the accomplishment of well laid and carefully devised plans in which a genuine pleasure would result from their fulfilment. In view of this the author feels the full liberty given in the selection of assistants and the discretion allowed in obtaining the information desired with the timely suggestions and instructions issued from time to time by the U. S. Board of Engineers largely contributed to and facilitated the obtaining of the results desired. The hearty co-operation of my assistants in charge of the several divisions of the work was largely instrumental in its accomplishment.

DIFFICULTIES ENCOUNTERED IN BUILDING A SEWAGE STORAGE WELL AT CONCORD, MASS.*

By Leonard Metcalf, Assoc. M. Am. Soc. C. E.†

In the spring of the year 1898 the town of Concord, Mass., undertook the construction of a sewerage system for the central portion of the town. Plans were prepared by the writer for a system comprising the building of 6½ miles of pipe sewers, a storage well, a power station which was to provide room for the municipal lighting plant as well as for the sewage pumping plant, one mile of 10-in. cast-iron force main, and 3.3 acres of sand filtration beds upon which to dispose of the sewage.

The amount of sewage to be pumped was estimated at 240,000 gallons per 24 hours under normal conditions. For economy in operation, the capacity of this well and the pumps was made such that the pumping would be confined to the hours of running the municipal lighting plant, thus requiring no additional attendance and reducing the cost of operation. The sewage pump was to be run by steam furnished by the municipal light plant boilers, at times of light load upon the dynamos—in the early afternoon and late night hours—discontinuing pumping when the light load was heaviest—in the early evening hours—and thus equalizing the work of the boilers. The plan also provided that later, when the Concord Junction should be connected with the system, an additional storage well should be built there, to store the day flow and let it down into the Concord sewage well during the night, when the sewage discharge was a minimum and the pumps were operating.

The storage well was located on the meadows near the Boston & Maine Railroad tracks, between Lowell Road and the Sudbury River, and about 650 ft. from the latter. This meadow lies within the valley of the river, but 5 ft. above the level of mean low water, and is submerged by the spring freshets to a depth of 1 or 2 ft., and, in extreme cases, to a depth of 5 or 6 ft.

A test-pit was dug on the site of the storage well to a depth of about 10 ft., and iron pipes were driven down in this excavation to the depth of the foundations, to show the character of the material to be encountered, and to enable bidders to figure intelligently upon this structure, which bade fair to offer some difficulty in construction. It is interesting at this time to recall the fact that several contractors who had contemplated bidding on the work refused to do so when they saw the nature of the material in which this well was to be built.

The original design for the storage well contemplated a circular well 60 ft. in internal diameter, 23 ft. in depth to bottom of foundations, with 24-in. brick walls, inverted segmental groined arch bottom of concrete, laid upon a timber foundation; elliptical groined arch roof of concrete supported on 24-in. brick piers, 15½ ft. on centers, with a small screen chamber on the side similar to a manhole, into which the two sewers were to discharge and from which the pump was to draw its supply. The capacity of the well, up to Grade 97, or 3 ft. below low water in the river, was about 250,000 gallons. Manholes were also provided in the roof, for access to the inside of the well, and an 18-in. vent pipe leading to the boiler furnaces, with by-pass in the chimney. (The well as built is shown by the accompanying plan and section.—Ed.)

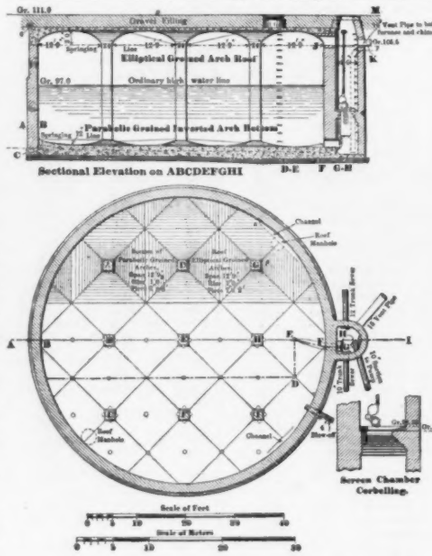
The construction of the storage well was included in the general contract for building the sewerage system, awarded to Messrs. T. W. Kinser & Sons, of Boston.

While bidders were at liberty to conduct the work in such manner as they chose, the following method of construction was suggested to them—the driving of a series of wells around the exterior of a line of splined and grooved sheeting surrounding the storage well, and the pumping down of the ground water-level or table to a plane below the foundation of the well. This method was perhaps unique only in the form of driven well required. The ordinary driven well could not be used, as the material was too fine for the finest screen and the amount of water too small. Hence it was suggested that the wells be constructed in the following manner:

First, sink a 10-in. casing by means of a water jet, driving the material out of the bore of the pipe. Remove the jet pipe and replace with a 3- or 4-in. screen pipe having suitable perforations and centered by guides to the bottom of the casing; and fill the space between the screen pipe and casing with moderately fine sand. Then withdraw the outer casing, leaving in place only the perforated pipe, now surrounded with moderately fine sand, however. Finally, insert a 1½- or 2-in. pipe in the perforated pipe, with its end near the bottom for the pump suction and draft through it. In this way it is believed that the ground water may be so lowered and kept down below the foundations as to prevent the forcing up of the bottom material as excavated, and as to make possible the successful dispatch of the work.

The method of construction adopted by T. W. Kinser & Sons, to whom the contract for the entire work had been awarded, was, briefly stated, that of driving two lines of sheeting around the outside and inside of the storage well wall and excavating the material between them, leaving the core to be excavated after the completion of the wall. Six-in. grooved spruce sheeting, with 2-in. splines, was driven by means of a pile-driver and water jet 30 ft. in depth to Grade 75, in a ring 67 ft. in internal diameter. About 7 ft. inside of this was driven a line of 4-in. tongued and grooved sheeting, 22 ft. long, on eleven chords of various lengths.

The excavation of the enclosed material was then begun Sept. 1, 1898. On top was found a layer of about 2 ft. in thickness of clayey loam or alluvium, followed by about 5 ft. of sand or gravel; underneath this a blue silt of the finest quality, similar to the infusorial earth found in the meadow near by, extending to an unknown



Plan and Section of Sewage Storage Well at Concord, Mass.

Leonard Metcalf, Assoc. M. Am. Soc. C. E., Engineer.

depth—more than 35 ft. below the surface of the ground. This fine material, when dry, was excavated with great ease, being of the consistency of cheese, but when wet it maintained a uniform level in the excavation and was tough and rubbery. The material was readily excavated to a depth of from 15 to 17 ft., but thereafter the difficulty increased rapidly, and the effort was made to sink the excavation in small sections by transverse bulkheads approximately 20 ft. apart. Progress was very slow, as new material was continually brought up from the bottom by the inflow of ground water, which was, however, small in amount, being handled from the greatest depth by one Edson hand pump. The material in the core and around the outside of the excavation gradually settled: the outside sheeting itself settled, and was driven in at the bottom until it occupied the position that the foundation wall itself should have; and transverse cracks appeared in the core and around the outside of the excavation. At that point, Oct. 9, work upon the structure was suspended by Messrs. T. W. Kinser & Sons, and the excavation was allowed to fill with water and remain in this condition until Nov. 1, when the entire contract was formally abandoned.

The probable cause of the failure of the method of construction adopted by the contractors is not difficult to trace. Material of this kind, when wet, is reasonably homogeneous and mobile, and transmits pressure in all directions in a similar manner to water. It requires but little water to make it run for a long time. Consequently the failure of the method is to be ascribed to the following facts: The failure to lower the ground water level to a point at or below the bottom of the structure; the driving of the outer line of sheeting to so great a depth below the foundation for the structure, without placing a hoop around the outside sheeting at its [illegible] only opportunity to brace the sheeting was [illegible] to the core as the material was excavated, large unbalanced pressure from the outside the bracing of the outside sheeting to the [illegible] self subject to deformation; and the drivi[illegible] sheeting supporting the core to so small a lower end was nearly exposed, in making for the foundations of the wall. Thus the outside sheeting was driven inward and the the unbalanced forces, while the sheeting locally and unequally as the work was various points around the ring.

No payment was made T. W. Kinser & [illegible] work, as the structure was in such a condit[illegible] the final execution of the work more difficu[illegible] sive than if nothing had been done upon it.

It seemed advisable thereafter to separat[illegible] well contract from the other work remaining [illegible] and on Jan. 6, 1899, a circular letter was sen[illegible] firms of recognized standing, who had handled work of this character, inviting bids upon the construction of the storage well. Two alternative designs were proposed—one being the original design, and the other that for a well of equal capacity, but of greater diameter, to clear the original excavation. The condition of the work was clearly set forth in the call, and a description was given of the method pursued by the former contractors and the probable cause of its failure. The right was reserved to pass upon the method of construction to be adopted, the plan originally suggested to T. W. Kinser & Sons being suggested as satisfactory to the commissioners, as well as the freezing and pneumatic processes, if not too expensive.

In response to this call six bids were received and the contract was awarded to the lowest bidder, Mr. Lucian A. Taylor, of Worcester. It is interesting to note, by way of comparison, that the original contract price of this work under the Kinser contract had been $7,950, while the highest bid for it out of the 16 bids received on the sewer work June 22, 1898, was $12,610.

Mr. Taylor adopted the method of construction first suggested by Mr. William Wheeler, M. Am. Soc. C. E., one of the sewer commissioners, and the writer, and on March 10, 1899, began driving the wells which were to be used in lowering the ground water. Fourteen wells were driven around the outside of the excavation to a depth of about 32 to 34 ft., and an open braced trench was dug around the outside of these through the gravel to the surface of the fine material, draining to two hand pumps located on opposite sides of the excavation. The wells were completed on March 29, a small pitcher pump being used on each driven well, and pumping was immediately begun and continued night and day thereafter.

It may be of interest to note that the sand, used as a jacket about the pump wells previously described, was a clean, sharp and moderately coarse sand. The analysis of it made by the writer showed it to be of an effective size (or 10% finer than), 0.25 mm., and to have a uniformity coefficient varying from 2.8 to 3.4.

On April 26 the excavation was begun, the core being excavated and the outside sheeting supported by a cellular and fan-shaped bracing. On May 9, finding that the 14 wells did not keep the ground water level down satisfactorily, Mr. Taylor drove 16 additional wells inside of the sheeting—half to a depth of 27 ft., the other half to a depth of 35 ft.—and pumping was continued night and day from that time until about the first of July.

Space forbids a recital of the many difficulties encountered in the execution of the work. Suffice it to say that on June 10 the bottom was excavated to about Grade 84—within a foot or two of the proposed foundation for the structure. The outside sheting, which had been left in such a deformed condition by the contractor the previous year, continued to settle so seriously and unequally as to make it impossible to keep the bracing of the structure in line. Indeed, it seems highly probable that, had new sheeting been driven in the beginning by Mr. Taylor and the old withdrawn, the work could have been executed much more rapidly and with far less difficulty and expense. On June 15 one of the 10 × 10-in. yellow pine through timbers in the bottom set of bracing gave way, and two days later the corresponding timber in the second or middle set failed, and that of the third set bade fair to follow. It was a most critical period. The outside sheeting, which had come in so at the bottom as to make it impossible to build the well of the diameter originally contemplated, without cutting the sheeting, continued to encroach more and more upon the core, and matters were in such a serious condition that it was feared the entire system of sheeting and bracing might gradually fail.

At this point the contractor was advised to put in an additional and new system of bracing throughout the bottom, adequately designed to hold the sheeting against further encroachments into the well, and in the interest of the immediate completion of the work a reasonable reduction in the size of the storage well was authorized upon certain specified terms.

In order that every possible precaution should be taken to prevent the collapse of the structure at such an anxious time, the writer asked Mr. Howard A. Carson, Chief Engineer of the Boston Transit Commission, to come to Concord to examine the work. This Mr. Ca[illegible] very

*Abstract of a paper read before the Boston Society of Civil Engineers April 18, 1900; reprinted from Jour. Asso. Eng. Soc., May, 1900.

†14 Beacon St., Boston, Mass.

kindly did ... personal sacrifice, and examined the work carefu... He expressed the opinion that in material of th... racter the failure, if it should occur, would not ... about suddenly, but gradually, and suggested that ... storage well could be somewhat reduced in ... might be possible to save the work which had ... done, by depositing concrete on the bottom of th... ation to stiffen the bracing, and by making certain ... itions to the bracing. Mr. Carson also kindly pe... dgment upon the thickness of the walls of the ch... as designed, and pronounced them adequate and ... factory. Steps were immediately taken to modify ... engthen the bracing, and concrete was deposited in ... bottom of the excavation. This concrete materially ... eased the thickness of the bottom of the storage ... requiring about 200 additional barrels of cement, ... ished by the contractor, but was undoubtedly the salvation of the structure.

A layer of screened gravel was first placed upon the surface. ... ctional platforms of 3-in. tongued and grooved spruce, covered with 2-in. tongued and grooved spruce laid at right angles and thoroughly spiked thereto, were cut in between the lower set of bracing timbers, resting upon the gravel. On these was deposited the first layer of concrete, pumping being continued until the concrete had thoroughly set, the water coursing underneath the platforms and along the lines of timber between the blocks of concrete. As the water pumped by the pulsometer pump carried about 9% of silt, some settlement of the platforms resulted, but not sufficient to cause serious trouble. The bracing timbers were thereafter cut out from between the blocks of concrete and replaced with concrete.

On this first layer of concrete, which was considered merely as a substitute for the continuous timber platform called for in the original design, was placed the concrete floor of the inverted parabolic groined arches. As the wall was built up upon this concrete base, the water was allowed to stand in the inside as well as on the outside of the structure, in order to equalize the pressure and do away with the necessity for further pumping, not only on account of the expense thereof, but also on account of the danger of future settlements resulting therefrom. It is interesting to note that in two cases where small horizonal cracks had opened in the brick wall when first laid, they closed as the height of the wall and the load upon the structure increased.

Thereafter the work upon the masonry progressed slowly but satisfactorily, the concrete floor invert being finished July 12, the brick walls Aug. 16 and the roof concrete Sept. 19.

While grave difficulties were encountered in the construction of this work, in spite of the method of building adopted, it is believed that they were primarily due to the condition of the sheeting at the inception of the work. This irregularity of the sheeting prevented the proper bracing of the structure and resulted in its deformation, due to unequal settlement, to such an extent as nearly to bring about the total collapse of the work. It is true that the ground water was never lowered quite to the bottom of the excavation, but this was probably due more to the form of pumps used and the spacing of the driven wells than to any inherent defect in the method pursued. However, the ground water was lowered within a distance of a few feet at most above the bottom of the excavation, and both the contractor and the writer feel certain that without the use of the driven wells the execution of the work would have been physically impossible, except by some such method as the pneumatic or freezing processes.

The storage well as finally built has an internal diameter of 57 ft., with a storage capacity in the well itself up to Grade 97, the assumed high-water level to which the sewage is backed up into the trunk line for a distance of about 3,000 ft., across the meadows, of 222,000 gallons; brick walls 24 ins. in thickness reduced to 20 ins. in the last 10 ft., vertically; an inverted parabolic groined arch bottom of concrete of 12¾ ft. span, 1 ft. rise, and varying, as previously described, from 2 to 3 ft. in thickness (nominally 1 ft. at the invert crown); and an elliptical groined arch roof of concrete of 12¾ ft. span and 3 ft. rise, supported on 24-in. brick piers 14¾ ins. on centers. The roof concrete is 6 ins. in thickness at the crown, the space over the piers being filled in and giving a horizontal plane surface to the top of the masonry.

The total combined capacity of the storage well, screen chamber and trunk sewers is as follows:

	Gallons.
Up to Grade 92.5, the invert of the 12-in. trunk sewer	128,000
To Grade 97, the contemplated ordinary high sewage level	242,000
To Grade 100, mean low water in the Sudbury River	319,000

The concrete in the floor and the roof was made of Atlas Portland cement and screened gravel, mixed in the proportions of 1 part of cement to 2 parts of sand to 5 parts of gravel. The brick walls were built of hard burned sewer brick, laid in Atlas Portland cement mortar, mixed 1 part of cement to 2 parts of sand; plastered outside with a ¼-in. layer of Portland cement mortar mixed 1 to 1 and thoroughly troweled; and inside with a grout of the same laid on with a plasterer's brush.

The contract cost of the storage well to the town, exclusive of cement, was $14,800; the total cost, including ironwork, cement, etc., but exclusive of engineering, was $16,955. The estimated cost to the contractor of the storage well floor was 74 cts. per sq. ft.; of the brick walls, $11.17 per cu. yd., including the cost of cement; and of the roof, 38½ cts. per sq. ft. The average thickness of the roof concrete, as figured from formulas deduced by the writer* was 0.92 ft.

Mr. Taylor estimates his loss upon the storage well contract as something over $2,000, making the total cost to him $16,800, due primarily to the length of time required for building the structure and the resulting high cost of pumping, which had to be done by hand and which was continued night and day from about April 1 to July 1, 1899. The work is, therefore, the more creditable to Mr. Taylor, as, in spite of the great difficulties of construction, cost and time required, the structure stands to-day complete, secure and well built.

*See "The Groined Arch as a Covering for Reservoirs and Sand Filters; Its Strength and Volume." Proc. Am. Soc. C. E., May, 1899.

COMPOUND DUPLEX LOCOMOTIVE FOR THE McCLOUD RIVER R. R.

The McCloud River R. R., in California, runs through one of the great lumber regions, and was built to develop the resources of this region, as described in our issue of July 27, 1899. It is a standard gage line, 20 miles in length, with grades of 2% to 4% and curves of 15°. The first locomotive was an ordinary mogul, and the next was a heavy Baldwin tank engine, with six coupled wheels and a pony truck at each end. Afterwards a Heisler geared engine was put in service (Eng. News, July 27, 1899). The latest engine is of the twin or duplex type, consisting practically of two locomotives coupled back to back. A somewhat similar design has been used in Europe, Mexico and India, but in the two former cases most of the engines have continuous main frames, with the driving wheels carried in swiveling frames, acting as trucks.

COMPOUND DUPLEX LOCOMOTIVE; McCLOUD RIVER R. R.
Baldwin Locomotive Works, Builders.

The new engine, which is illustrated herewith, consists of two six-wheel engines, set back to back and coupled together, and having the operating mechanism so arranged that the engineman operates the machine as one engine from either cab. The cabs are built without the usual extended hoods, but one of them has a raised hood covering the space between the two roofs. The engines are Vauclain four-cylinder compounds, without trucks, and have the deep form of diamond smokestacks set on extension smokeboxes, which form spark or cinder receptacles. One engine has a saddle tank extending down to the running boards. The other has a tank on top of the boiler, while on each side is a cage of iron posts and steel wire to hold the wood used for fuel. The engine is designed to haul a load of 125 net tons up a grade of 7%. It was built by the Baldwin Locomotive Works, of Philadelphia, Pa., and we are indebted to the builders for photographs and other particulars. The general dimensions are as follows:

Driving wheels	3 ft. 4 ins.
Driving wheel centers	2 " 10 "
Journals	6½ × 8 "
Wheelbase of each engine	9 ft. 9 "
Wheelbase, total	38 " 4 "
Weight in working order	161,400 lbs.
Cylinders, h. p.	11½ × 20 ins.
Cylinders, l. p.	19 × 20 "
Slide valves	Balanced piston.
Boiler, straight top; diam.	3 ft. 10 ins.
Boiler, barrel plates	½-in.
Boiler, working pressure	200 lbs.
Firebox, size inside	53 11/16 × 34⅜ ins.
" depth	59 "
" side and back plates	5/16-in.
" crown plate	⅜-in.
" tube plate	½-in.
Tubes, 136; diam.	2 ins.
Tubes, length	12 ft. 9 "
Heating surface; tubes	1,804 sq. ft
" " firebox	148 " "
" " total	1,952 " "
Grate area	26 " "
Capacity of tanks, aggregate	2,400 gallons

THE RESOURCES OF SIBERIA were lately commented upon by Mr. Emile du Marais, a civil engineer, who has passed many years in Russia, and is a member of the Russian section of the French Bureau of Foreign Commerce. As noted by U. S. Consul John C. Covert, of Lyons, Mr. du Marais says that 200,000 farmers annually arrive in Siberia, the government giving them free transportation and the free use of 37½ acres of ground for a stated time. The present population of Siberia is 8,000,000; and on the basis of European population, it could support 80,000,000 people. The "black lands" of Siberia cover 133,550,000 acres; and the annual product of cereals is now 2,000,000 metric tons, of which about one-third is exported. The country can produce 10,000,000 metric tons annually; and it is estimated that it can export butter, wool, leather, dried and preserved meats to the value of $15,500,000 per year. Few of the gold mines are worked, on account of the climate, and enormous coal deposits are hardly touched; one coal mine alone is said to equal in volume all the coal deposits of England. High freight rates are the trouble now in all export business. The average freight rate on the Trans-Siberian railway is about one-half cent per ton per mile.

KITE OBSERVATIONS are reported upon by the U. S. Weather Bureau, in connection with extensive investigations of wind velocity, temperature and relative humidity of the air. Seventeen kite stations have been established at various points and daily observations are made when the weather permits. The records cover 2,000 ascensions made up to 3,000 ft. As a general result, they find the temperature to decrease at an average rate of 5° per 1,000 ft. to an elevation of 5,000 ft. above the sea; when the temperature begins to increase again. The observers conclude that during a "cold wave" the belt of cold air is not over one mile high, and often is less than half a mile; and that there is a warmer stratum above it. Under normal conditions there is practically no difference in the wind direction at and above the earth's surface, the velocity slightly decreasing with the altitude. Humidity seems to follow the same general law; though some few exceptions were found, as at Omaha, where one observation showed an increase of 11° at 7,000 ft.

THE SHRINKAGE OF LAKE NICARAGUA is insisted upon by Prof. Angelo Heilprin, late President of the Geographical Society. In the "Scientific American Supplement," of May 19, 1900, he answers the paper of Mr. C. Willard Hayes, of the U. S. Geological Survey, refuting Prof. Heilprin's previous statements on this head. Prof. Heilprin discusses at length the rainfall of this region from 1880-98 inclusive, the annual evaporation and the outflow from the San Juan River. He assumes the annual evaporation at 55 ins. and the annual outflow of the river at 84 ins.; and then figures that in 1880-98, the loss in level was 363 ins. against a gain of 114 ins., or a net loss of 249 ins., or 20 ft. 9 ins. He thinks this outflow is 20% less than that figured by Childs in 1850, by the Nicaragua Canal Board of 1895, and the Nicaragua Canal Commission of 1898-99; and the evaporation assumed is 5 ins. less than that assumed by Mr. Arthur P. Davis, of the 1899 Commission. He concludes, therefrom, that Lake Nicaragua has undergone marked shrinkage in the last 25 to 50 years; that this shrinkage is progressive and cannot be compensated for under any known conditions; and that the earlier measurements of the lake's surface, by Galisteo in 1781, and Baily in 1838, can be assumed to be correct, though they show a lowering of 20 to 30 ft. in the lake level as compared with recent surveys.

ENGINEERING NEWS
AND
AMERICAN RAILWAY JOURNAL.

Entered at the New York Post-Office as Second-Class Matter.
Published every Thursday
at St. Paul Building, 220 Broadway, New York, by
THE ENGINEERING NEWS PUBLISHING COMPANY

GEO. H. FROST, - - - - - - - - - PRESIDENT.
D. McN. STAUFFER, - - - - - - - VICE-PRESIDENT.
CHARLES WHITING BAKER, SECRETARY AND MANAGING EDITOR.
F. P. BURT, - - - TREASURER AND BUSINESS MANAGER.

WM. KENT, E. E. R. TRATMAN, } ASSOCIATE
M. N. BAKER, CHAS. S. HILL, } EDITORS.

A. B. GILBERT, - - - - - - - ASSISTANT MANAGER.

CHAS. W. REINHARDT, - - - - CHIEF DRAFTSMAN

ALFRED E. KORNFELD, New York,
M. C. ROBBINS, Chicago,
S. B. READ, Boston,
C. F. WALKER, Cleveland,
} ADVERTISING REPRESENTATIVES.

PUBLICATION OFFICE, 220 BROADWAY, NEW YORK.
CHICAGO OFFICE, 1636 MONADNOCK BLOCK.
BOSTON OFFICE, 170 SUMMER ST.
CLEVELAND OFFICE, OSBORN BUILDING.
LONDON OFFICE, EFFINGHAM HOUSE, 1 ARUNDEL ST., STRAND.

SUBSCRIPTION RATES: United States, Canada and Mexico, One Year, $5.00; 6 months, $2.50; 2 months, $1.00. To all other countries in the Postal Union: Regular Edition, One Year, $7.00 (31 shillings); Thin Paper Edition, One Year, $6.31 (26 shillings). SINGLE COPIES of any number in current year, 15 cents.

In requesting change of mailing address, state BOTH old and new address; notice of change should reach us by Tuesday to be effective for the issue of the current week. The number on the address label of each paper indicates when subscription expires, the last figure indicating the year and the one or two preceding figures the week of that year; for instance, the number 320 means that subscription is paid to the 32d week (that is the issue of Aug. 9) of the year 1900; the change of these figures is the only receipt, unless one is sent by special request.

ADVERTISING RATES: 20 cents a line. "Want" and "For Sale" notices, special rates, see page XXI-XXIII. New copy for standing advertisements should be received one week in advance of publication; new advertisements, Monday morning. The pages containing "Want," "For Sale" and "Proposal" advertisements are held open until Wednesday noon.

The development of a fleet of freight carriers, designed to operate on the Great Lakes during the summer, and in the Atlantic coasting trade during the winter, when lake navigation is closed, is among the probabilities of the near future. As many of our readers know, a notable change has taken place in the methods of Great Lakes transportation during the last few years. The bulk of the lake iron ore, grain and coal traffic formerly handled by individual carriers is passing into the hands of large interests owning or controlling fleets of specially-constructed vessels of enormous capacity. The Bessemer Steamship Co., controlled by the Rockefellers, has a fleet of 60 of these very large ships; the Minnesota Steamship Co., owned or operated by the Federal Steel Co., has 25 ships; the American Steamship Co., of the American Wire & Steel Co., has twelve vessels; the Carnegie Co., operating the Pittsburg Steamship Co., has eight vessels, and to these must be added the ships of the National Steel Co., the Mutual Transportation Co., and the Republic Iron Co., owning five, four and three steamships, respectively. In this fleet of 117 lake carriers the great majority of the vessels are of the largest size and of the very latest lake model; they are built for special work, and fitted with every modern appliance for handling cargoes quickly and economically. These large vessels, however, are constructed for lake service alone; can only work during the lake season, and cannot leave the lakes by any existing route.

As a result of this condition of affairs the individual carriers on the lakes are making their plans for a service that can operate both on the lakes and outside of the lakes. This scheme is made feasible by the chain of Canadian canals, now practically completed, which extends from the Atlantic to the Great Lakes, and offers passage for all vessels of 14 ft. draft and not exceeding 260 ft. in length. A fleet of five ships is now being built in England for a Canadian syndicate, which are especially designed for this service. Each ship is 243 ft. long, 36 ft. beam, with a molded depth of 19½ ft., and 1,578 tons gross tonnage. They are designed to have a loaded draft of 17 ft., but will pass the canals, to or from the Atlantic, on a 14-ft. draft. These vessels are constructed to carry a large load on a comparatively light draft; so that in any year when no longer available for lake trade, they can be sent to the Atlantic and compete for coastwise trade during the winter. By their peculiar build and light draft they would have an advantage over the ordinary coasting steamer, in avoiding expensive lighterage charges. Four vessels of Welland Canal size have also been contracted for by American interests, and a new departure seems to be fairly made in radically changing the character of the lake traffic.

The bulk of this new type of steamships will doubtless be built upon the lakes; for nowhere else is the material so convenient and so cheap, from the iron ore to the finished plate and beam. Lumber is abundant, and skilled labor is plentiful for all that enters into the making of a ship. The ultimate outcome of the increase in the carrying capacity of lake steamers and facilities for handling cargo, combined with the possible continuous use throughout the year of a large part of the carrying fleet, should result in a still greater reduction of freight rates, and a lowering of the cost of manufacturing iron and steel.

THE MASTER CAR BUILDERS' AND MASTER MECHANICS' CONVENTION.

While the proceedings of the recent conventions of the Master Car Builders' Association and Master Mechanics' Association did not present any matters of special importance to arouse such exciting discussions as have been a feature of some of the earlier conventions, yet there were many points of general and technical interest, to which attention may be called. In the first place, the new plan of holding both conventions consecutively in one week proved to be an entire success. The former plan, as our readers know, has been to hold one convention in the latter part of one week and the next convention during the first three days of the next week. The objection which some have made to the new order of things, that six days of discussion would be too much for the members (many of whom belong to both associations), and that they would neglect business towards the close of the week, proved to be entirely unwarranted. The meetings were all well attended by men who remained through the entire proceedings, and the interest and discussion were unflagging from beginning to end.

Two features of the convention arrangements call especially for favorable comment. In the first place, the programs allotted a certain time to each subject, and while it was, of course, impossible to follow this arrangement in its entirety, it was followed quite closely, and aided materially in having the proceedings carried out in a prompt and businesslike way, without waste of time. This plan was largely due to the Secretary of the two associations, Mr. J. W. Taylor. In the second place, there was but one organized excursion to distract attention, and that was one of technical interest. At too many technical conventions, the morning session is hastily closed to allow members to snatch a hurried luncheon, and go off on some pleasure excursion, with the result that the proceedings are not as carefully deliberated as they should be. At Saratoga, there were no distractions, but members were free to do as they pleased after the meeting. Thus there was plenty of time for the business of the conventions, and the members spent the greater part of the leisure time sociably around the hotel. This gave ample opportunity for the interchange of ideas and the making or renewing of acquaintanceship. It also incidentally inured to the benefit of the ubiquitous and hospitable supply men, whose exhibits were a perpetual source of attraction, while it has occurred at some conventions that there has been scant time for a full examination of the exhibits. In this connection, it may be appropriate to note that the exhibits as a whole formed an interesting exhibition of American railway appliances.

Coming now to the technical part of the proceedings, one of the most important subject[s] before the Master Car Builders' Associ[ation] was that of having the mechanism of auto[matic] couplers maintained in proper working [condition]. The President, in his address, quoted the following extract from the latest annual report [of the] Interstate Commerce Commission:

> A very large number of cars have been found [in which the] appliances for operating the couplers, especially the [uncoupling and] locking machinery, were so out of order and [in such a condition as to be unusable] that though the cars were actually provided [with] automatic couplers they could not be uncoupled [without] the trainmen going between the cars, and in some [cases] obliged to resort to mechanical assistance in [order to get] the cars apart. Such a coupler is not automatic [in the] sense contemplated by the law. Its use subjects [trainmen] to risks and dangers which are obviously greater [than] those which existed when the old link-and-pin [coupler was] employed.
>
> In view of the conditions disclosed by the inspectors' reports, it seems vital that the uncoupling attachments shall be kept in perfect working order, and there should also be general uniformity in the construction, application and operation of such attachments. In a hazardous employment, the man does his work with greatest safety who has the least need to think how the act is to be done. If he does it always in the same manner he does it mechanically and unerringly. The uncoupling attachments used with automatic couplers do not all operate alike, and some of them are characterized as confusing to the trainmen. The Master Car Builders' Association, which has done so much good in establishing standards of uniformity, appears to have fully considered this matter. In 1897 and 1898 that association recommended a practice as to the application of uncoupling levers and attachments, which we suggest should be followed. It is important for the safe performance of his work, much of which is done in the darkness of the night and often in storms, that the trainman should be able to determine by the position of the lever whether the coupler is in the locked or unlocked position. He can do this with uniform construction and application of the uncoupling levers, if the attachments are kept in repair.

It may be mentioned that under the action of this convention, the suggestion to change the M. C. B. standard so as to have the uncoupling lever extended to both sides of the car, will be submitted to letter ballot. This same matter was referred to in relation to the report of the Committee on Standards and Recommended Practice. This report stated that the supplementary report of the Interstate Commerce Commission, containing the reports of the inspectors, show a "lamentable condition" of uncoupling attachments on many cars, and suggested that a rule should be established under which cars delivered with defective uncoupling attachments would have to be repaired, with a requirement that the attachments be maintained in good order on all cars, home or foreign. Later on, however, it was explained that there is already such a rule, and that it is only necessary to have it strictly carried out. Under this rule the delivering company is responsible for cars having the uncoupling attachments of M. C. B. couplers inoperative when offered in interchange. It was also stated that some makes of couplers have the chain much lighter than that required by the M. C. B. standards, as was shown by samples taken from some of the couplers on exhibition. Yet these couplers are being accepted by the railways without protest. Enforcement of the rules is evidently as necessary as revision of the rules.

In this same connection, reference may be made to the discussion on the proposition to use solid knuckles, since the use of link and pin couplings for cars in interstate traffic will be illegal after Aug. 1. The proposition was not received with any enthusiasm, however, and the use of links (or bars) and pins for coupling cars on sharp curves, for coupling narrow and standard gage cars, and for coupling to cars on ferry-boats and floats, were suggested as difficulties in the path. The inability of coupling a solid knuckle M. C. B. coupler to an automatic coupler now in limited use which does not couple in a vertical plane, was also suggested as a complication in this respect. It would certainly seem, however, that as the M. C. B. vertical plane type is so widely used and established as a standard, it should not be necessary to make it fit any other form of coupler, but rather that other forms should be made to fit the M. C. B. type if they are to be put in use. Probably at the next convention, when there will be available some months of experience under the coupler law,

the asso[illegible] will be more ready to take decisive action on [illegible] matter. Certainly, uniform design and proper working condition should be two matters very properly looked after in regard to automatic couplers.

The committee reported that the adopted gages for [illegible] and wear of couplers are now being made, and that the detailed plans of the adopted form of [illegible] testing machine have been prepared. The authorities of Purdue University have made an offer to establish a machine of this kind at its own expense, subject to the use of the association for official research, the university to furnish assistance in subsidiary apparatus and to use the machine for educational and commercial purposes. This offer has been accepted by the association. A somewhat novel recommendation of this committee was to the effect that as couplers are now being purchased on a guaranteed life they should be "date marked" in the same way that air-brake hose are marked. Raised figures would be cast on the bar, and these, representing the date when the coupler is put in service will be obliterated, thus establishing a record of the date.

The proposition to change the carbon percentage for axles, as required by the present specifications, was an important matter, but it very soon appeared that it was far too deep and important to be settled offhand, as meddling with the chemical composition of steel might involve serious results. The matter, was, however, referred to a committee for investigation. The repairing of steel car trucks was another important subject, the best opinion on which appears to be that railways must prepare to provide facilities for repairing steel cars and trucks. The use of steel is now so general and is extending so rapidly that the woodworking shops for car repairs will have to be largely supplemented or superseded by machinery and appliances similar to the equipment of boiler and machine shops. It will soon be entirely impracticable for a road to send a damaged steel car or truck back to the owner or builder for repairs, as such methods will interfere with traffic to an inadmissible extent.

The next group of subjects was in regard to brake equipment. In regard to the tests of triple valves, it appears that although the committee has expressed its willingness and desire to make new tests, with a view to reviving the specifications adopted as a result of the tests of 1886 and 1887, yet the New York Air Brake Co. still declines to submit its triple valve for test. This company claims that certain requirements of the specifications are unfavorable to its device, but that greater speed of emergency application in the New York brake fully offsets the higher pressure in the emergency application of the Westinghouse brake. The general opinion of the association seemed to favor new tests and a revision of the specifications to suit the present conditions of increased pressures, loads and speed, and improved brake equipment. Mention was made of a third air brake now being put on the market. No tests of brakeshoes have been made during the year, for though many new styles have been brought out, the committee did not consider that they were sufficiently well-established to warrant the expense of testing. The association seemed to think that some greater progress should have been made, but put itself on record as considering that tests should only be made of such brakeshoes as may be submitted by railways which are members of the association. Thus a manufacturer or inventor must secure the endorsement of some railway before he can have his device tested by the association. This seems a very reasonable rule, and is in line with similar rules in other associations. Similar action was taken in regard to the tests of M. C. B. couplers. One interesting point brought out was that shoes are being made which have an indefinite life, being so hard as to practically resist wear. This sounds well until it is explained that such shoes are very deficient in the frictional resistance upon which the braking efficiency depends. The resistance, and not the wear or life, is the matter of prime importance in a brakeshoe. As to brake rigging, it appears that the matter of adjusting it to give the correct piston travel is being somewhat neglected, with the result that the efficiency of the brakes does not reach its maximum. The injurious results of the practice of oiling brake cylinders by simply pouring oil into the cylinder, is also not properly understood, and it has been found desirable to make the cylinders without oil holes. In this way, it is necessary to remove the cylinder head, so that the interior of the cylinder and the packing leather and rings will receive proper attention at the time the oiling is done. These are matters for brake inspectors to see to.

The Rules of Interchange were formerly the source of much excited discussion, but they have now been so well revised year by year, in the light of experience with their working, that the discussions are now a rather tedious, though important, part of the proceedings. An entire revision of the passenger car rules was proposed, in line with the present style of the freight car rules, but this was not adopted.

Two important points of car equipment which came up for discussion were (1) the center and side bearings, and (2) the draft rigging. The styles of center bearings are so numerous and varied that the committee could make no recommendations, but the committee on side bearings rather got into trouble by speaking slightingly of roller bearings on the ground that the rollers will flatten. Members who have had experience with these devices stated that the nests of small rollers do not flatten, as did the old style with a single large roller to each bearing. In view of the enormous loads now carried, and the liability of such loads to cause the trucks to bind on curves, when the car body is down on the bearings, it certainly seems that the matter is too important to be lightly set aside. This was the opinion of one member of the committee, and was endorsed by the meeting, which referred the matter back to the committee, but at the same time gave the consideration of both center and side bearings to one committee, which is a rational arrangement, since the two are so closely related.

The committee on draft gear disagreed as to the arrangement of the springs, but united in condemning the present system as inefficient, and in suggesting that tests be made of such gear under service conditions. With the high tractive power of modern locomotives, wooden draft beams are found to be of insufficient strength and stability, and various forms of metal beams are being introduced. The springs, however, are the most seriously-defective part of the gear, their capacity being so far below that of the tractive power of the engines, that a train hauled by an engine exerting its maximum power may have all the draft gears practically solid, the capacity of the springs being exceeded. The design of draft gear for wooden and steel cars will again be considered by this committee.

The Master Car Builders' Association did a graceful act at the end of its proceedings, in electing to life membership a number of members who have been actively identified with the association and its interests for 20 or 25 years, and it was suggested that at some future time the by-laws be so changed that each year such members as have reached this term of membership will be honored by being transferred to the grade of life members. The Master Mechanics' Association, which is less businesslike, and whose constitution is admittedly defective, got into trouble and wasted considerable time in trying to elect certain members as honorary members. It was rather pointedly remarked in the course of the discussion that there is no assurance of members elected under the present system being worthy of the honor, and further that their election in the face of such opposition as had developed, could hardly be considered in the light of a compliment or an honor. This latter association had two committee reports relating to its affairs, the first on methods of increasing the usefulness of the association, and the second on the extent to which its standards are adopted. The latter was certainly rather discouraging, and would seem to indicate that the members of this association are less aggressive or less broad-minded than those of the M. C. B. association. The report on the ton-mile basis of keeping motive power statistics provoked some discussion, but this presented few new features, and the general impression seemed to be that further investigation is necessary.

Taking up the subject relating to the construction of locomotives, it may be noted that a length of 20 ft. for 2-in. boiler tubes was considered entirely practicable, and some rather surprising figures were presented by Mr. Vauclain, showing that the maximum length in this country is now 16 ft. 7⅝ ins., while abroad it has already reached 18 ft. 1 in. Metal cabs were favorably considered on all points except weight. Piston valves were also very favorably spoken of, and some of the members were evidently surprised at the extent to which these valves are already in use, both in simple and compound engines. The compound locomotive received somewhat of a "boom," but Mr. Rhodes rather checked the enthusiasm by the timely reminder that the railway mechanical departments cannot take very much of the credit of introducing these engines. Their part has been very secondary to that of the locomotive building firms and their agents, in dealing with the higher officials of railway companies. Large orders for compound locomotives are more often the result of these influences rather than of the influence of the superintendents of motive power. The compound locomotive, in its various forms, is now well established, but it is well to remember that the mechanical departments have done but little towards the design or improvement of the engine.

The use of flanged tires upon all the wheels of engines having three pairs of coupled driving wheels, was discussed at some length, and was generally regarded with favor. On the other hand, however, some of the most prominent speakers suggested that while this plan might be satisfactory as far as the engine alone was concerned, yet the results might be obtained at the expense of the track, with increased wear of rails and greater tendency to loosen the fastenings and spread the gage. A matter of this kind, which relates so closely and in so important a manner to the motive-power and maintenance-of-way departments should be fully considered by both departments before definite action is taken upon it by either one department.

The criticism has sometimes been made, that this association has devoted too much of its attention to the locomotive and its details, but at the Saratoga convention there were two good reports on shop equipment. The first of these was a conservative but clear and favorable report on the use of electricity for transmitting power in railway shops, while the second dealt with the style of boiler for use for shop purposes. This latter report recommended that more attention be given to methods of effecting economy in boiler service by superheating the steam.

The technical part of the proceedings was conducted in a thoroughly successful manner, but (as at all these conventions) some of the committee reports were unsatisfactory from the fact of their being mainly a compilation of the replies to circulars of enquiry sent out. Such individual information has a certain value in itself, but its main object and importance is to serve as the basis for certain reasoning, deductions or conclusions, and the committee which contents itself with presenting a mass of indigested information in this way is in need of new blood to bring it up to the required standard.

Besides the technical part of the proceedings, the conventions were an entire success in other ways. The weather was ideal, and the accommodations were excellent, the latter especially being a matter that has an important relation to the success, and which in this case called for very favorable comment. In fact, the suggestion was made in two or three quarters, that Saratoga might well be selected as the place for the next convention, if not as a permanent place for holding these conventions.

LETTERS TO THE EDITOR.

First Impressions of the Paris Exposition.

(Editorial Correspondence.)

The American who comes to Paris in these days generally comes prepared to be disappointed in the Exposition. Much has been published in American and English papers of the delay in completing buildings and installing exhibits, and of the gaps in the display where this or that great industry of America or England is poorly represented. It is easy thus to gain the idea that it is perhaps not much of a show after all.

One must be very prejudiced or blase, however, if he retains such an idea after he reaches Paris and makes a few tours through these huge buildings; and I do not see how he can avoid the conclusion that this is the greatest and most truly international exposition that the world has ever seen. Comparison with the last great World's Exposition at Chicago is, of course, inevitable; and one is more forcibly impressed than ever here with the wonders that Chicago accomplished. That to a city a thousand miles inland and separated by an ocean's width from the Old World civilization, it should have been possible to bring so great a display of Europe's best works as was there shown, is indeed a marvel.

It must be remembered that Paris is the real metropolis of Europe. Its exposition, marking the close of the century, has been a greater event in the eyes of European nations than our Columbian Exposition at Chicago could possibly have been. Besides this, it is as easy to assemble at Paris the products of European factories and the results of her progress in art and science as it will be to bring to Buffalo next year exhibits from all the States east of the Mississippi.

Small wonder, when all these things are considered, that the display of European nations at Paris this year should greatly exceed that which was brought together at Chicago.

As a spectacle, the Paris Exposition does not make such an impression as did the splendid "White City," but this is due largely to the lack of space. The quadrangles formed by the buildings around the Champ de Mars and those on either side of the Esplanade des Invalides are indeed beautiful, yet they lack in some sort the magnificence of the famous "Court of Honor," and one looks in vain for such a landscape as was seen when one entered the gates at Chicago and saw that wonderful display of architecture set in such an adequate framing of trees and lakes and lawns.

Nevertheless, no mistake was made in the choice of a location at Paris. To have placed the exposition away from the center of the city would have given greater opportunities for the display of architecture, but the problem of transporting passengers would have been insurmountable, and even with the Exposition located close to the center of the city as it is, Parisian transportation facilities are inadequate to handle the crowds.

The prevailing color of the exposition buildings is white. Not the dazzling white of the Chicago buildings, but a cream shade that forms a better ground work for the painting and decoration which has been so lavishly applied. We were not such pastmasters in decorative art as the French; and having created beautiful structures in a pure and classic style we hesitated to go far in the use of color at Chicago. The Parisian knows no such fear—every smooth surface is a fair field for the brush of the mural painter. Every projection is seized upon to support some beautiful moulded figure or group. The final result is a richness of ornamentation that, however pleasing, and well executed in detail, gives on the whole a less restful effect than a simple and more classic style.

I have said the decoration is pleasing in detail; but there are cases where this is not true, and where the passion for decoration and a general joyful effect has overstepped itself. The most conspicuous instance, of course, is in that much criticised main entrance, with is sky-blue arches, dotted with bulls-eyes of red glass. These latter were an addition deemed necessary for the production of pyrotechnic effects in electric illumination at night, but they seriously injure the appearance of the structure in the day. The facade at the end of the Champ de Mars suffers in the same way, though in much less degree.

I have already alluded to the delay in installing exhibits of which so much has been said. It is apparently true that during the first three weeks of the exposition so many of the exhibits were incomplete as to be a constant annoyance to the visitor. This is not the case now. One can still see, indeed, in every department workmen putting finishing touches here and there, and a few exhibitors who are constructing special buildings for their displays, have apparently a month's work still ahead of them. The incompleteness of a few exhibits, however, is hardly of importance when there is spread before the visitor in complete display far more than he can adequately examine in many weeks' diligent labor. The American who is postponing his visit to Paris until the show is ready, may pack his trunk at once. What is incomplete when he arrives will be ready for his inspection by the time he has seen all the rest.

It will naturally be asked whether the United States is behind all other nations in getting its exhibits completed. I can give only a general impression; but that would be that this is not the fact—at least when the cases are deducted where the delay is due to the loss of exhibits shipped by the ill-fated "Pauillac." There certainly seem to be plenty of English exhibitors behindhand with their work, and what is most surprising, there are not a few French exhibitors who are still busy getting their space in readiness to admit the public.

For the most part, this, like every other great exposition, is merely a great display of manufactured goods of every sort under the sun. The bulk of the exhibitors show their wares for the advertising—direct and indirect—which they derive, and they count on reaping a profit. I believe the exposition authorities, however, were anxious, so far as possible, to go somewhat further than this and to make the exhibits in some sort at least instructive, and they have succeeded in quite a remarkable degree. To illustrate, I have never seen anywhere such a remarkable display of models as is shown here. There are models of factories and industrial plants of every description, railway terminals, harbors, cities, bridges, earth-works, in fact of everything in engineering construction. Most of the displays of this sort can bring no return whatever to their exhibitors; but it is displays of this sort which make a great exposition something different from a mere collection of store windows.

Besides the models, most exhibitors have made great use of photographs and drawings—which often tell a story far more clearly than either an actual machine or its model. They represent, of course, comparatively small outlay; but their number is so great that the engineer in search of all the work exhibited in even a limited field will find this task no light one.

The provisions for the comfort and convenience of the visitor which the exposition authorities have made are admirable. Toilet rooms of all grades and prices, from "de luxe" down, abound. Restaurants, cafes and buffet benches are everywhere; and from the number of their patrons one is forced to the conclusion that the main purpose of those who enter the exposition gates is to find something to eat and drink. The only problem of comfort not solved is transportation. It is not so much the distances between buildings, as the miles upon miles of aisles in the buildings themselves, which the visitor traverses until his legs refuse to move further. He drops into a convenient chair for a rest and up pops a damsel from nowhere, and demands "dix centimes" as rental for the seat!

To go from the one main part of the exposition grounds to the other, a distance of about three-quarters of a mile, there are two modes of conveyance, the moving sidewalk and an electric railway. The former is similiar to the one which was in operation at the Chicago Exposition on the long pier where the steamboats landed; but it is so located here as to be of much greater service, and it is carrying large numbers of people. It is a novelty in passenger transportation which deserves more attention than it has received, and there are places, I believe, where it could be adopted to great advantage. The speeds here are quite slow, that of the faster side only three or four miles an hour; but as there are no seats on it, one can walk along upon it in the same direction in which it is moving and thus get over the ground quite rapidly.

As already said, neither the moving sidewalk nor the electric railway helps the weary visitor in his walk up and down these interminable aisles. There is a rolling chair brigade, but they are too "de luxe" for the ordinary visitor, and if they were not there would not be enough to go around. What is needed at all these great shows is a wheeled chair in which one can propel oneself about, not at bicycle speed, but at the rate of an ordinary walk. Perhaps some enterprising Yankee will have them ready for the next great World's Fair. If he doesn't, I feel sure the Frenchmen will, for they are hitching motors to every sort of vehicle now, and doing it with a large degree of success.

C. W. B.

Paris, June 7, 1900.

The Progressive Combustion of Gunpowder and Credit for Its Development.

Sir: I have a copy of your esteemed publication of April 26 before me, and my attention has been directed to a long illustrated letter, entitled "The Progressive Combustion of Gunpowder and the Credit for its Development," undersigned Hudson Maxim. In answering your correspondent's letter, I am influenced, first, in view of certain professional services which I have rendered, it behooves me to refute some of the misleading inferences made in that letter; second, by the fact that the concluding paragraphs of his letter are in the form of personal attacks, and are apparently calculated to inflict professional injury upon myself.

The first striking feature of Mr. Hudson Maxim's letter is, that he seems to have learnt at last that someone other than himself at one time made multi-perforated powder. When he came to England several years ago trying to sell his powder, the multiple perforations were most emphatically claimed by him as original and valuable, and it was not before he brought his powder before Mr. Hiram S. Maxim that he learnt that that gentleman had already patented it in England. It was upon this occasion that his "assistant," Dr. Schuepphaus, openly declared that "Hudson Maxim never made an ounce of powder in his life, and that he couldn't make an ounce if his life depended upon it." This detail, which is vouched for to-day, in London by persons of high repute, is inserted not so much for its direct importance as its extraordinary significance at a time so opportune.

Mr. Hudson Maxim says: "Many marked copies of London periodicals have recently been sent to editors of American papers and others containing articles claiming Mr. Hiram S. Maxim to be the inventor of both tubular and multi-perforated powder grains, and the originator of the whole idea of accelerating or progressive combustion."

With reference to the above statement I know nothing. Regarding the claims of Mr. Hudson Maxim[illegible] tor, and the novelty of his patents as compared with the earlier patents of Mr. Hiram S. Maxim, I have on several occasions rendered reports accompanied by specifications, but I was never engaged to investigate, nor have I ever advised, as to the origin of multi-perforated or progressive powder.

Progressive powders were, however, dealt with in at least five of the patents of Mr. Hiram S. Maxim as early as 1885 and 1886, which is some five or six years before Mr. Hudson Maxim appeared upon the scene as claimant to distinction on the subject of gunpowder.

Mr. Hiram S. Maxim was known to use multi-perforated powder grains in 1890, but his later patent was for longitudinally perforated cylinders, which were to vary according to the length of the powder chamber.

Mr. Hudson Maxim also says that when actions are compared with the editorials, which have been published with the reports rendered by me, a peculiar light is thrown on the whole matter. I am quite content to leave this to the judgment of the interested public, whose benefit I shall quote Mr. Hudson Maxim's remarks, together with "actual facts" in order that that "peculiar light" may be thrown or reflected with absolute freedom of conviction.

Mr. Hudson Maxim says:

Mr. Hill cites the British patent of Hiram S. Maxim, No. 17994 of 1894, in which are shown and claimed the tubular and other forms of grains illustrated in figure 9 for the purpose of accelerating combustion. Mr. Hill then cites four of my United States patents, Nos. 538618, 540326, 540327 and 540328, for the die illustrated in figure 4, and for cartridges, in which multi-perforated grains are shown but not claimed. These patents, Mr. Hill says, were not applied for "until after 1895," and about a year after the above British patent of Hiram S. Maxim. On referring to these patents, it will be seen that they were filed in the latter part of 1893 and the beginning of 1894, about eight months earlier than the application of Mr. Hiram S. Maxim for the English patent referred to, etc.

The "facts" of the case are: that in that section of my report which treats upon the subject of multi-perforated powder, I pointed out eleven patents which had been applied for in the name of Hudson Maxim, all of which were of subsequent date to Mr. Hiram S. Maxim's British patent referred to, namely, 17994-94. Out of the eleven patents cited, Mr. Hudson Maxim has selected only four, which I believe are the earliest of the group. The dates of these patents are as follows: (These documents are open for public inspection at The Astor Library, N. Y.) Brit. Pat., No. 17994-94, H. S. Maxim, dated Sept. 21, 1894; U. S. Patent No. 538618, April 30, 1895; 540326, June, 4, 1895; 540327, June 4, 1895; 540328, June 4, 1895.

The object of the search which terminated in the report to which I have referred, was to ascertain for publication to what extent Mr. Hiram S. Maxim and Mr. Hudson Maxim were justified in asserting the conflicting claims for certain inventions relating mostly to munitions. It will therefore be seen that the inventions of Gen. Rodman or Mr. Wiard had no bearing upon the question. The search was a comparative one, and intended to distinguish novelty to that extent only; therefore, it was equally immaterial whether Mr. Hudson Maxim claimed in his patent the powder which resembled the earlier invention of Mr. Hiram S. Maxim or only made use of in connection with his own name, and consequently these "facts" remain exactly as originally set forth in my report.

Mr. Hudson Maxim does not seem to have learned the meaning of the word "Dated," which is found upon the specifications of patents for inventions. "But this is no more extraordinary" than his ignorance of the difference between "patents applied for" and "patents granted."

In concluding, I will endeavor as far as possible to more correctly appropriate that expressive phraseology employed by my wounded aggressor. "As" (Mr. Hudson Maxim professes to be both an engineer and a chemist) "it would be doing an injustice to his professional skil to presume that he made these misstatements through ignorance. In view of the actual facts of the case which I have here presented, I believe that many readers will guess that" (there was some other motive). Le motif est dans l'homme.

Thomas A. Hill.

London, England, May 18, 1900.

(In accordance with our usual custom we submitted a proof of the above letter to Mr. Hudson Maxim, whose reply to it follows. With the publication of these letters the discussion of this matter in our correspondence columns will be closed.—Ed.).

Sir: The statement made in Mr. Hill's letter, which appears herewith, that I claimed to be the originator of multi-perforated powders may be proven to be absolutely false by referring to my lecture before the Society of Chemical Industry in London on June 14, 1897, and also to page 25 of my book entitled "The Maxim Aerial Torpedo," published in London by Eyre & Spottiswoode, the British Government printers, in 1897, from which I quote the following:

We are aware that a multi-perforated grain of powder is not novel; but that form of perforated grain whereby the highest ballistic results are secured is novel, and a rod or strip of powder having transverse perforations as an article of manufacture is entirely new.

If further evidence is wanting, it is only necessary to

of my patents have I ever made the to me by Mr. Hill, which I certainly had they been new.

By ref... the British Patent No. 17,994 of 1894, which M... has frequently cited to prove that Mr. Hiram S... was the first and original inventor of multi-perf... powder, it will be seen that claims there- in are m... dily for "tubular and other forms of per- forated p... in utter disregard of the state of the art at the ti...

The st... made by Hill which he attributes to Dr. Schuepph... proven false by the two letters from Dr. Schuepph... which are appended.

The st... by Mr. Hill that he "was never engaged to invent... and that he has never advised as to the origin of ... perforated or progressive powder, is rather curious in ... w of the fact that this is the very thing that he did ... and report upon, both in "Feilden's Maga- zine," and ... London "Engineering," claiming most em- phatically that Mr. Hiram S. Maxim was the inventor of multi-perforated powders and that this important inven- tion was "fully disclosed" in his British patent. Fur- thermore, I have a letter from Mr. Hill, in which he states that he was so engaged.

In Mr. Hill's present communication in the fourth para- graph from the end, he gives a list of some of my United States patents, which he says were of subsequent date to Mr. Hiram S. Maxim's British patent, No. 17,944 of 1894, and calls attention to the fact that these documents may be seen at the Astor Library. It will be found by refer- ring to these patents at the Astor Library that Mr. Hill has given the date of application of Mr. Hiram S. Maxim's patent, and the date of issuance of my several patents. Reference to these patents will show that they were all applied for eight months previous to the application of the said patent of Hiram S. Maxim, and that all of them were issued previous to the issuance of his said patent. The misleading character of this statement of Mr. Hill is a fair example of the methods being employed by this gen- tleman.

Mr. Hill does not seem to appreciate that the little fact of having secured an earlier filing date in the United States counts for anything as a patent record, if not also filed in England. He furthermore overlooks the fact that no search for novelty is made in England, and that a Brit- ish patent is no guarantee whatever of novelty, while in American a most rigorous search is made and a broad patent is a pretty good guarantee of novelty.

Very respectfully,
Hudson Maxim.

891 Sterling Place, Brooklyn, N Y.

Sir: Mr. Hudson Maxim has shown me proof of a com- munication sent to you by Mr. Thomas A. Hill. Though I have never met nor even heard of Mr. Hill, he imputes to me the statement that "Hudson Maxim never made an ounce of powder in his life, and could not make an ounce if his life depended upon it." To refute this assertion I can do no better than enclose the copy of a letter which I wrote to Mr. Hudson Maxim from Charlottenburg, Ger- many, on the 17th of September, 1898. You would oblige me, if you would kindly print this letter in conjunction with this one.

Respectfully,
Robert C. Schuepphaus.

174 Broadway, N. Y., June 8, 1900.

Hudson Maxim, Esq., New York city.

Sir: Your letter of August 30 was received, telling me of the statements made by Mr. Hiram S. Maxim about smoke- less powders and his claims to being the inventor of im- portant methods and processes, and his further assertion that many of the important features of the Maxim-Schuepp- haus smokeless powder originated with him and were taken from him.

I have been long aware that he was making some such claims. In fact, in the fall of 1896, I was told in London by Mr. Albert Vickers that he had understood from Mr. Hiram S. Maxim that all the important methods employed by us were taken from him, and that they were his inven- tions. Mr. Hiram S. Maxim was forced to acknowledge before Mr. Alfred Vickers in my presence that any such conclusion in regard to the Maxim-Schuepphaus powder as Mr. Vickers might have arrived at through remarks of his, was false, and that not a single feature of this powder originated with him. I have in my possession a letter addressed to me and signed by Mr. Albert Vickers for Vickers, Sons & Co., Limited, dated London, Nov. 2, 1896, which closes as follows:

We undertake not to manufacture this powder without having made an arrangement satisfactory to yourself.

Anybody who is familiar with the history of smokeless powder and the actual processes of manufacturing these powders knows that none of Mr. Hiram S. Maxim's in- ventions is being used to-day in the commercial produc- tion of any smokeless powder in the world.

You may give any publicity you wish to this letter, in order to meet the unfounded claims made by Mr. Hiram S. Maxim, and also to show that as we stood together and shared the work and the trials in the production of the Maxim-Schuepphaus smokeless powder, there is now no disposition on the part of either of us to rob the other of the full measure of credit deserved, and we stand together in sharing the credit as we did in sharing the work.

Sincerely yours,
Robert C. Schuepphaus.

Charlottenburg, Germany, Sept. 17, 1898.

Notes and Queries.

A correspondent wishes to secure the addresses of Mr. H. Van Vleet, formerly Chief Engineer of the New Or- leans, Mobile & Chattanooga R. R., and of Mr. K. W. Rogers, also of the same road.

THE UNITED STATES MINERAL AND METAL produc- tion for the fiscal year of 1899, says the advance sheets for "The Mineral Industry," published by the Scientific Publishing Co., had a value of $1,211,361,861, as compared with $861,751,017 in 1898. Of this sum ores and minerals contributed $580,836,032; metals, $496,057,320; secondary products, $63,996,969. The value of metals smelted or re- fined from foreign materials was $70,471,540. Coal and coke hold the first place, with 25.4% in value of the total; pig iron comes next, with 20.9%, including ferro-manga- nese; copper amounted to 8.3%; clay products were 6.1%; and gold is fifth in order, with 5.8% of the total; petroleum is sixth, with 5.3%; stone, 3.5%, and silver is eighth in order, with 2.8%. The pig-iron output in 1899 was 13,- 400,735 long tons, worth $234,725,754; against 11,560,165 tons and $110,168,732 in 1898. Of this output in 1899, 8,202,778 long tons were Bessemer pig, and 985,033 tons basic pig. The Portland cement production last year amounted to 5,805,620 barrels of 400 lbs. each, valued at $10,441,431; as against 3,584,586 barrels and $6,168,106 in 1898. The iron-ore output was 25,341,000 long tons, against 20,655,865 tons in 1898. The value of the gold mined in 1899 was $70,096,021; and that of the 57,126,834 ozs. of silver was $34,036,168.

THE CHICAGO RIVER has been reported upon by Major J. H. Willard, U. S. Engineer, in connection with his investigation as to the effect of the Drainage Canal upon the flow of the river. He states that while there is no doubt that the reversed current in the river has in- creased the difficulty in navigating it with large boats, it is a noteworthy fact that the pilots have been quick to adapt themselves to the new conditions, and that they could handle the boats in greater currents than now ob- tain. He recommends that no restrictions be placed upon the legal requirements of flow into the canal unless it should be found absolutely necessary to do so. The en- gineer department of Chicago and the Sanitary District are of one mind as to the need of improving the Chicago River, are co-operating heartily to that end, and large sums are appropriated and being expended ju- diciously by each for the objects in view. The interests of navigation are not only being protected, but are being advanced practically sooner than could be hoped for in the usual course. As to the discharge of water based on his measurements, Major Willard says that it is probably safe to estimate the mean velocity of the sections at about 80% of the maximum, giving an average of less than one mile an hour for discharge not exceeding 20,000 ft. a minute and less than 1½ miles an hour for discharge not exceeding 310,000 cu. ft. a minute, and therefore the gen- eral current of the Chicago River must be much less.

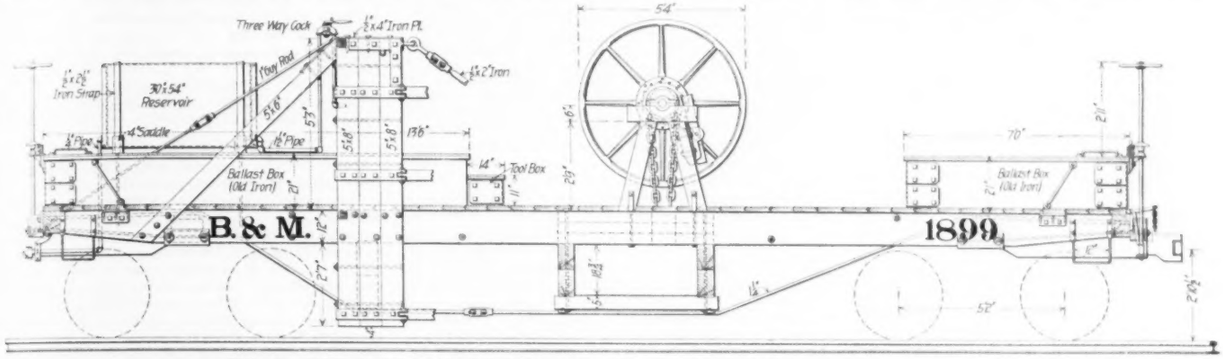


FIG. 1.—SIDE ELEVATION OF DITCHING AND SPREADING CAR; BOSTON & MAINE R. R.

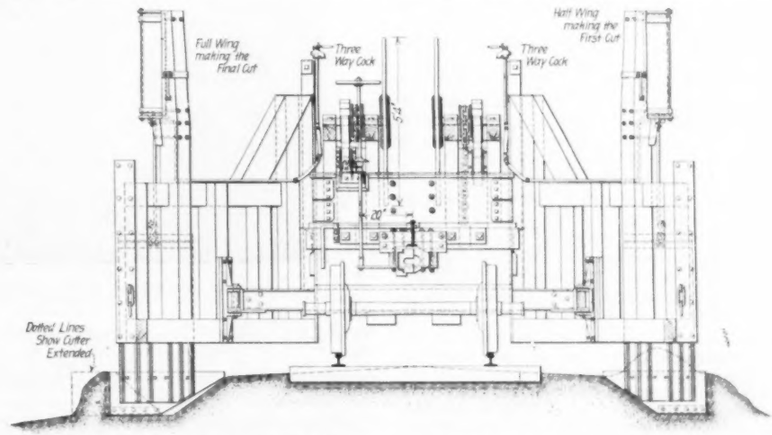

Full Wing making the Final Cut
Three Way Cock
Three Way Cock
Half Wing making the First Cut
Dotted Lines Show Cutter Extended

FIG. 2.—REAR ELEVATION OF DITCHING AND SPREADING CAR; BOSTON & MAINE R. R.

SPREADER CAR; BOSTON & MAINE R. R.

For leveling material deposited from gravel or construction trains for the purpose of ballasting or widening the roadbed or embankments, exten- sive use is made of what are commonly termed spreader cars. These are generally flat cars fitted with adjustable wings and mold boards of various

forms, which spread and level the earth or ballast, and trim out to the desired slope at the side. Different forms of spreader cars are used by different roads, and we illustrate herewith a car of this kind built in 1899 at the shops of the Boston & Maine R. R., at Concord, N. H., and used for a variety of purposes. It was designed and patented by Mr. Frank Barr, Assistant General Manager, B. & A. R. R.

The machine consists of a specially-built flat car having wings which are fitted with interchangeable knives or cutters. The wings can be extended or contracted and the cutters raised or lowered either by hand or by air. A 10-in. cylinder attached to a support which is part of the wing is used to raise and lower the cutter, but the cutter can be raised and lowered by means of a rack and pinion with a wheel attached to the opposite end of the shaft to which the pinion is secured, the rack being secured to the cutter. By using air, there is a saving of the labor of three men, as one man can operate the cutters by air, but four men are required to raise or lower them when both wings are being used on a single track, or two men, if only one wing is being used. The car is rated at 70,000 lbs. capacity, and is fitted with composite steel and wood bolsters and M. C. B. couplers. It is 34 ft. long and 6 ft. 4 ins. wide over the sills, and the bolsters are 24 ft. 8 ins. apart, c. to c. There are four longitudinal sills; the two side sills being each composed of two timbers 5 × 12 ins., bolted together, while the two other sills are 5 × 8 ins. There are four 1¼-in. truss rods, with a truss depth of 24 ins. below the sills. Fig. 1 is a side elevation of the car, and Fig. 2 is a rear elevation, showing the shape to which the wings cut and trim the roadbed.

One of these cars was in use during the season of 1899. It was employed for leveling the subgrade for a parallel track, or any work calling for the displacement of material within reach of the machine, such as widening out a bank or grading for additional tracks. By extending the wings, gravel or other material can be leveled off to a width of 12 ft. or more from the track and to any depth desired not exceeding 18 ins. All surplus material may be removed from both sides of the roadbed on single track and from the outside of double track, to leave a uniform shoulder of any shape desired, cut with lines parallel to the rail, whether on straight or curved track. A uniform cross section is thus obtained, and the drainage of the ballast is said to be greatly improved, thus reducing the work of shimming during the winter. Weeding and ditching can also be done by means of this car. The work cannot only be executed with perfect uniformity, but it can be done without the employment of larger crews of laborers and the saving over the cost of doing the work by hand is estimated at 85%. The force required to operate it properly in addition to the locomotive crew, consists of a train crew, a foreman and four men. The amount of track covered in a day's work will depend upon the kind of material, the amount moved, the width of the bank over which the material is to be put and the frequency of trains. The car has moved 500 cu. yds. of bank filling, leveling it off 6 ins. below the tops of the ties, and 10 ft. from rail, for a distance of 1,000 ft. in 25 minutes. The following is an extract from a roadmaster's report on one piece of work done:

I took the standard cross-section which was given by the Engineer's Department at that time, and kept figures on the cost of putting the shoulder on, which was practically the same as put on by the shouldering car, and I found that it cost us about $75 a mile. This would allow about 100 ft. a day per man. To cover the thirty miles, which we did in four days' time with the car, it would have taken 375 men four days at a cost of $2,025. The total wages of men in the shouldering car outfit were $114. To this expense should properly be added $378, the wages of 70 men employed in leveling back material which the car could not reach, and clearing up material, in cuts that the car could not dispose of, making the total expense $492.

THE APPEARANCE OF THE AUSTIN DAM AFTER THE HIGH WATER SUBSIDED.

The accompanying view of the remains of the Austin dam was taken the first part of this month, after the high water had gone down. The camera was placed on the top of the west bluff, about 750 ft. below the dam. In the foreground, the sand bar deposited below the dam by the current may be seen, and in the distance the present river channel for a short distance above the dam. The conditions at Austin, as they appeared on or about June 9, were described in more detail by Professor Taylor, in a brief article which appeared in our issue of June 21.

ANNUAL CONVENTION OF THE MASTER CAR BUILDERS' ASSOCIATION AT SARATOGA, N. Y.

The 34th annual convention of the Master Car Builders' Association was held at Saratoga, N. Y., June 18, 19 and 20, the headquarters being at the Grand Union Hotel, and the meeting being held in the Saratoga Theatre. On Monday, June 18, the meeting was called to order soon after 10 a. m., and in accordance with the usual custom the proceedings were opened with prayer, the Rev. Mr. Delos Jump, of the Methodist Episcopal Church, officiating. An address of welcome was then delivered by Mr. John Foley, President of the Village Board, who suggested that the association should adopt Saratoga as its permanent convention town. The annual address was then delivered by the President, Mr. C. A. Schroyer (Chicago & Northwestern Ry.), in which he pointed out that while the increase in number of cars represented had been only 8,730 for the previous year, the increase in tonnage capacity had been in very much greater proportion. The association now represents 1,356,861 cars. Touching on the subject of the M. C. B. automatic coupler, Mr. Schroyer read a letter from the Interstate Commerce Commission, stating that a very large number of cars have been found in which the mechanism, especially that for unlocking, is out of order, so that men have to go between the cars to uncouple them. Such couplers subject the men to greater dangers than those existing with the old link-and-pin coupler. The Secretary, Mr. J. W. Taylor, then presented his report, showing that the association has now 265 active members, 190 representative members and 8 associate members, or 463 in all, while 11 members have been lost by death during the past year. The report of the Treasurer, Mr. T. W. Demarest (P., C., C. & St. L. Ry.), showed that the funds in hand now amount to $9,836. The announcement was made that the dues had been set at $4 per vote, as usual, and committees on nominations, auditing and resolutions were appointed. The first committee report on the program was then taken up.

Supervision of Standards and Recommended Practice.

This report was read by Mr. A. M. Waitt (N. Y. Central R. R.), and recommended the following three changes, which will be submitted to letter ballot:

As experience has shown a considerable breakage in the back end of the journal box for 5 × 9-in. journals on 80,000-lb. cars, the opening at the back end (corresponding with the dust guard) should be increased in width from 6⅝ ins. to 6¾ ins.

A standard brake pipe nipple, 10 ins. long, should be located directly back of the angle cock, so that in the event of the threaded end of the pipe being damaged, it could readily be repaired by introducing another nipple, instead of having to take down the whole length of pipe.

The uncoupling arrangements for M. C. B. couplers should be modified by extending the uncoupling lever to both sides of the car, instead of to one side only, as at present.

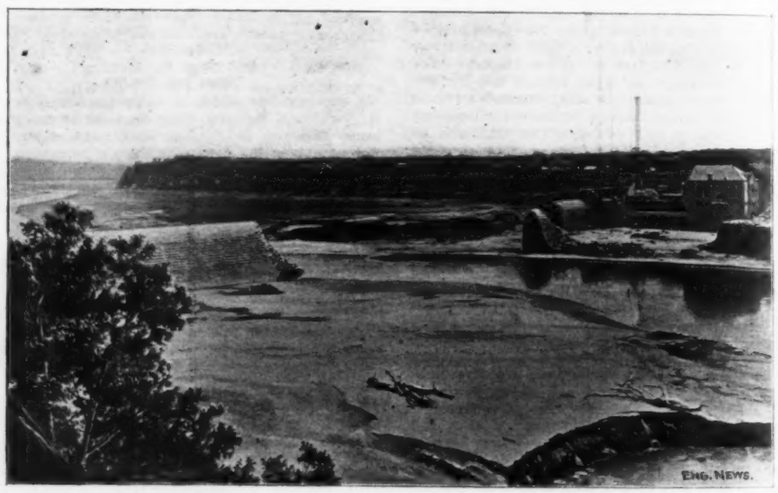
Two recommendations for discussion as to bolt heads and car axles, were taken up later. Mr. Waitt supplemented the report by a statement from the Interstate Commerce Commission suggesting that decisive steps be taken to ensure the uniformity of unlocking movements and the keeping of these and all other safety appliances in proper condition. The reports of the inspectors of the commission show a lamentable condition of the uncoupling attachments. The matter was referred to the Committee on Arbitration, with a request that a report be prepared covering the subject, the idea being to require any road replace missing parts of these attachments on foreign cars and to require the attachments to be maintained in good working order on all home and foreign cars. That committee explained, however, that such a rule already exists, and only needs to be enforced.

Bolt Heads and Nuts.

This subject was made a special subject for discussion, as noted above, for the reason that by some oversight the recommendations made by the committee last year were not submitted to letter ballot, as had been intended. These recommendations were in favor of a smaller head than the present standard, conforming to the "manufacturers' standard." For square-head bolts the short diameter of the head to be 1½ times the diameter of the bolt and the thickness of the head to be half the diameter of the bolt. No change to be made in square nuts. Mr. G. W. Rhodes (Burl. & Mo. River R. R.) thought the matter should be taken up with the American Master Mechanics' Association, American Society of Civil Engineers and American Society of Mechanical Engineers.

Carbon Percentage and Car Axles.

This also was a special subject for discussion. Mr. Waitt explained that the specifications adopted last year set the carbon proportion at 0.35% minimum and 0.45% maximum, but some members thought the limit too high for axles in freight car service, where hot boxes are liable to be cooled off by throwing water on them. Such treatment may crack or check the collar, and cause it to break off afterwards. He moved that the limits in the specifications be changed to 0.25% minimum and 0.40% maximum. Mr. Nelson and Mr. Forsyth, of the Committee on Axles for 80,000-lb. Cars, thought it unwise to make any changes without very careful consideration, the chemical composition of axle steel being a matter of too great complication and importance to be treated hastily. Mr. Simons (Pittsburg Coal Co.) thought the matter further complicated by the fact that many roads using axles with journals 4¼ × 8 ins. for passenger cars, take them out after making a certain mileage and transfer them to freight cars. On motion, it was voted to refer to a special committee the question of specifications for the chemical composition of steel for axles for cars of 60,000 lbs. and 80,000 lbs. capacity.



VIEW OF AUSTIN DAM FROM BELOW, AFTER THE FLOOD HAD SUBSIDED.

The two topical discussions on the program were then taken up.

Repairs of Pressed Steel Trucks.

In opening this discussion, Mr. B. Haskell (Pere Marquette R. R.), took the ground that repairs should be made by the manufacturers or owners, as such work would be out of the question on some roads. Most of the speakers, however, including Mr. G. W. Rhodes, took the stand that steel trucks are now being so extensively used, and their use is increasing so rapidly, that the roads should prepare themselves to make the necessary repairs. The delay and trouble incident to sending damaged trucks from a distant point to the maker or owner would cause serious inconvenience. Steel cars and steel trucks are now so well established that the railways must of necessity make repairs themselves, as is already done in many cases with entire satisfaction. Mr. Rhodes, however, sug-

gested th[e] ...ufacturers would do well to design and construct ...ical parts of cars in such a way that the railways ...air them, a matter which is often overlooked.

...Weighing and Stenciling Cars.

The di... was opened by Mr. F. A. Delano (C., B. & Q. R. ...no stated that the rule for re-weighing cars every ... mainly a dead letter, while some car owners and rail... are intentionally cutting rates by marking the light ... 1,000 to 2,000 lbs. more than the actual light ... At the present time many commodities are weighed ... out of the car, or the car is weighed loaded ... empty, causing delay and expense which would not be ... ary if the marked light weights were recognized ... rect, accurate and reliable. Mr. Simons instanced ... troubles in this respect, and referred to the variation ... weight of a car when wet and when dry, and to the ... rance of cleaning out hopper bottoms, etc., before ... are weighed. On motion of Mr. Waitt it was voted that a special committee should be appointed to report on uniform methods and practice for re-weighing home and foreign cars, including the reporting of the results to owners and the recommendation of charges for such service.

Closing the Link Slot in the M. C. B. Knuckle.

This special subject for discussion was presented by Mr. G. L. Potter (Penn. Lines), who pointed out the importance and the practical advantages of closing the slot and pin hole in the knuckle, these being less necessary as the link and pin coupler becomes obsolete, while the strength of the knuckle would be greatly increased. One member thought that making the knuckles too strong would result in an increase of guard-arm breakages, which would be more expensive than knuckle breakages. Mr. R. H. Johnson (St. Louis Southwestern) stated that his road is using knuckles without the slot, but retaining the pin-hole, so that on sharp curves where the knuckles will not couple, pins are put in and a link put over their heads. Mr. Simons (Pittsburg Coal Co.) has curves so sharp that a 3-ft. bar is required between cars to keep the corners from interfering, and as sharp curves are so numerous at terminals and industrial spurs, he thought some means must be provided for coupling cars on such curves. Mr. G. W. Rhodes stated that narrow gage cars in mixed trains also complicate the matter to some extent in the West, and that the roads using an automatic coupler which does not couple in a vertical plane might also make trouble. We have referred to this matter in our editorial columns. Mr. H. S. Hayward (Penn R. R.) and Mr. L. T. Canfield (D. L. & W. R. R.) referred to the necessity of a special means of coupling for taking cars on and off a ferry float or apron, link or bar couplings being often required. Mr. Schroyer (C. & N. W. Ry.) stated that last year 54% of the broken knuckles on his road were broken through the upper pin hole, due to the use of crooked pins, which would not go through to the lower hole. Mr. F. A. Delano (C., B. & Q. R. R.) suggested making the slot 1½ ins. wide, instead of 2 to 2¼ ins., as at present.

Breakshoe Tests.

The report of the Standing Committee on Brakeshoe Tests was very brief, as follows:

> At the time of last year's convention it was thought it would be desirable to make further tests during the year, on account of new brakeshoes being introduced. The committee, however, finds that so many of the brakeshoes now being presented are still in an experimental condition, that it would not be wise to go to the expense of conducting further tests until some of the shoes already on trial shall have demonstrated their efficiency in service sufficiently to lead the committee to believe that they will continue in use.

In explanation of this brief report, Mr. S. P. Bush (C., M. & St. Paul Ry.) stated that the committee had considered that it was not its function to keep on indefinitely testing shoes brought out by inventors, but only to test those which are in actual service for more than experimental purposes. As it is difficult to distinguish between experimental and service use, it was decided to postpone action. He also stated that brakeshoes are being introduced which wear almost indefinitely, but these are not satisfactory, since they do not give the requisite frictional resistance. Mr. Delano (C., B. & Q. R. R.) and some other speakers stated that they referred manufacturers of brakeshoes to the association's testing plant (now at Purdue University) before they would talk business with them regarding their brakeshoes. Prof. W. F. M. Goss, of Purdue University, stated that tests of six or eight kinds of shoes had been made. While the expense is small, it is sufficient to shut out some, and he suggested an arrangement by which the work would be done for the association at a lower charge than that made to manufacturers. Mr. A. M. Waitt and Mr. Schroyer thought that the committee should not be at the service of any manufacturer or inventor, but should test only such shoes as are presented to it by a railway company belonging to the association. Mr. Wagle (N. Y. Central R. R.) thought the tests should take into consideration the coefficient of friction, the wearing qualities of the shoe and the scrap value of the shoe. Others thought this was requiring too much, the wearing quality being something for the user to settle for himself. A motion was eventually adopted instructing the committee to test such brakeshoes as may be presented to it by railways represented in the association, and which seem to have made sufficient departure from those previously tested to have affected their efficiency and durability; also, that the committee shall formulate specifications governing the limitation of the coefficient of friction for a satisfactory brakeshoe.

The meeting then adjourned for the day, about 2 p. m. The afternoon was spent mainly among the exhibits, no regular excursions being organized, and in the evening there was a vaudeville entertainment at the Saratoga Theatre.

On Tuesday, June 19, the first subject on the program was the report of the Standing Committee on

Triple Valve Tests.

Mr. G. W. Rhodes (Burl. & Mo. River R. R.), Chairman of the Committee, made a statement showing that the committee had endeavored to make progress with its tests, but that the New York Air Brake Co., after sending a representative to attend the preliminary meeting, declined to co-operate or to make any recommendations. Failing to secure the co-operation of one of the two brake companies, it was considered inexpedient to make any tests against the wishes of that company. No changes in the recommended practice were offered by the committee.

Mr. G. W. Rhodes.—It is generally conceded that the tests of 1886 and 1887, participated in by a large committee, helped by a number of mechanical men interested in various types of brakes, were gone into very thoroughly and very carefully, and the result of the specifications which

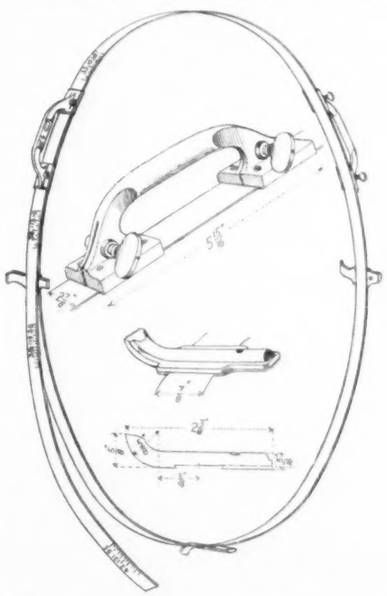


Fig. 1.—Proposed Wheel Circumference Measure, M. C. B. Association.

were finally adopted by the M. C. B. Association were mapped out after these careful and thorough tests had been made. At that time the members of the committee were all very close to the tests and to the rack tests, and were very familiar with their work and with what the results might be if specifications different from those adopted were brought about. When we were asked to change those specifications (after all that careful work) we naturally did not feel inclined to change them. Since that time improvements have been made in brakes and car equipments, speeds and loads have been increased, and it might be that conditions and specifications for brake requirements which were deemed desirable in 1887 and 1888, might be subject to modifications at the present time, and therefore the committee was quite willing—and personally I believe it is quite time—to make a reinvestigation of this important subject, and if it is found that the specifications are too severe or too lenient and are not applicable to the present demands of railway service, modify them.

Mr. C. A. Schroyer (C. & N. W. Ry.)—Under the requirements of our specifications, in making the emergency application, we get an excess pressure in the emergency cylinders over what is obtained with some of the other brakes, and they are not able to meet that. Is that an essential, or is it not? The other brake companies claim that the increased speed made by them in the application of their brakes on the rear cars of the train, is such as to fully or more than offset the advantages that we gain in the excess pressure in the emergency application. If that is so, our requirement in that particular respect is probably more than it should be, and in that case should not our specifications be modified?

Mr. W. S. Morris (Ches. & Ohio Ry.)—I have investigated the triple valves of the New York Air Brake Co., as compared with those that are standard on our road. The company claims that the application in emergency is so much quicker that it is equal to the additional pressure that is introduced into the cylinder in the emergency feature of the Westinghouse. Of course we could not tell what that would be on the regulation test under the Master Car Builders' requirements. It seemed to be a good point, however, and I urged the representative to give us the triples and go into the test, but the company seemed to think that a test is not necessary. It feels that it has a good brake in service; objects to the rack test, and depends on the service test which the committee proposed to make in connection with the rack test. If all the brake companies (there is another air brake coming on the market) give us their co-operation for a test, there is no reason for them to feel that we will not give them justice.

The report of the committee was adopted, and the next subject taken up was the

Revision of the Interchange Rules.

This discussion occupied considerable time, but was mainly in regard to matters of detail, few important changes being suggested. A suggestion to reduce to diameters of wheel fits of axles for cars of 70,000, 80,000 and 100,000 lbs. capacity was referred to the Committee on Standards and Recommended Practice. Rule No. 3 (Section 16) was changed so that renewals of axles having the fillets at the back shoulder worn out will be charged to owners. This was followed by the report of the Standing Committee on Prices in M. C. B. Interchange Rules, which recommended an increase in prices, in view of the general increase in prices of material. The report was accompanied by tabular statements of present and proposed prices, but no changes in the labor charge were recommended. In discussing the second-hand prices allowed for destroyed equipments, the question was asked whether these referred to wooden and steel construction, to which Mr. J. H. McConnell (Union Pacific Ry.) replied "there is no destroying a steel coal car." Following on the same line, the report of the Committee on Revision of Passenger Car Rules was presented, in which an entirely new set of rules was submitted. These are much more detailed than the present rules, and are based upon the present freight rules. By the time these various matters relating to the question of interchange had been discussed, the hour of adjournment had arrived, and the meeting was adjourned for the day.

On Wednesday, June 20, the meeting was called to order promptly at 9 a. m., the first business being the reading of the report of the Nominating Committee. This was followed by the consideration of a supplementary report from the Arbitration Committee regarding certain changes in the Rules of Interchange. Mr. G. W. Rhodes (Burl. & Mo. River R. R.) stated that the unsatisfactory condition of uncoupling attachments on M. C. B. couplers is largely due to the connections being too light and too weak. The links and clevises are often of ⅝-in. iron, instead of the M. C. B. standard ⅝-in., as proved by examination of some of the coupler exhibits, and such connections are not strong enough to stand the jerking in service. The rules as amended during the convention were then adopted as a whole. The report of the Auditing Committee was read, endorsing the accounts, and the technical committee reports were then taken up.

Wheel Circumference Measure.

The design of the present measure was presented by the Committee on Standard Wheel Gage in 1882. In February, 1900, your committee issued a circular asking what changes were desirable in the present design, and a design (Fig. 1) was submitted by one of the members, which meets with the approval of your committee.

It will be observed that at proper distances on the gage there are vertical marks indicating the correct theoretical circumference measure for 33-in., 36-in., 38-in. and 42-in. wheels, the same information being given for 26-in., 28-in. and 30-in. wheels in their respective positions. On the left-hand side at the top the diameter of wheel indicated is stamped, and on the right-hand side is the correct corresponding circumferential measure, thus: 33-in. wheels, 103.67 ins.; 36-in. wheels, 113.10 ins.; 38-in. wheels, 119.38 ins., and 42-in. wheels, 131.95 ins.

On each side of the vertical lines are spaced six shorter vertical lines ⅛-in. apart. By this method of measurement, if a wheel were exactly the correct circumference the indicating slide on the scale would cover the center line. If the wheel were larger in diameter, the indicating slide would fall short of the center line by 1, 2, 3, 4 or more marks, and such a wheel would be indicated as + 1, + 2 or + 3, etc., showing that the circumference of the wheel was ⅛-in., ¼-in., or ⅜-in. more than the correct standard. If the indicating slide extended beyond the center line, the circumference of the wheel would be less than the standard and would be indicated in the reports as — 1, — 2, — 3, etc., showing that the wheel was ⅛-in., ¼-in. or ⅜-in. less than the proper size. With this method of measurement more uniformity in the matter of inspection and mating of wheels can be obtained, and the inspector will have a clearer idea of what the marks on his circumference measure really indicate. The committee would recommend the adoption of this measure in lieu of the present wheel circumference measure. J. J. Hennessey, E. S. Marshall.

Mr. F. A. Delano (C., B. & Q. R. R.) asked why the steel tape was shown as ⅞-in. wide. He uses a tape ⅝-in. wide, and thinks the narrower the better. Mr. J. J. Hennessey (C., M. & St. P. Ry.) stated that many of the largest roads recommended the greater width. The report was accepted, and the matter will be referred to letter ballot. The next subject was the report of the Committee on

Journal Box, Bearing and Wedge for 100,000-lb. Cars; Also Journal Bearing and Wedge Gage for 80,000-lb. and 100,000-lb. Cars.

Your committee, instructed to prepare plans for a journal box, brass and wedge for 5½ × 10-in. axles for cars of 100,000 lbs. capacity, and limit gages for journal bearings and wedges for cars of 80,000 and 100,000 lbs. capacity, submits drawings for these parts (Fig. 2); also drawings for journal bearing and wedge gages for cars of 80,000 and 100,000 lbs. capacity, made on the same lines as the present standard gages for these parts, with sizes increased to suit the proposed wedge and brass.

In preparing these plans it has been the aim to design the parts, as far as possible, with a view of using present

standards without detriment to the design. This has been found practicable with regard to the journal-box lid only. The present standard lid for 5 × 9-in. boxes is of sufficient size to cover the necessary opening in the proposed 5½ × 10-in. box, by reducing the overlap on each side.

The size of the box is kept as small as possible to decrease weight and increase its strength, with special reference to making the box of sufficient capacity for oil and waste, and at the same time limiting that capacity to an amount that will be sufficient for proper lubrication, but will not admit of a wasteful or unnecessary amount. We recommend that the box be made with circular bottom, as it has all the advantages that have already been discussed relative to that point; at the same time it is recommended to allow the square bottom to come under the list of standards for any who may prefer this bottom, either for a larger oil capacity or other preference. The box, wedge and brass as described will interchange with the box, wedge and brass now in use on about 15,000 cars of 100,000 lbs. capacity, which are practically all the cars of this capacity now being operated. Wm. Garstang, J. J. Hennessey, W. H. Marshall.

Mr. Wm. Garstang (C., C., C. & St. L. Ry.) stated that the committee had endeavored to design a box which would interchange with those now in service on 100,000-lb. cars. Mr. F. M. Whyte (N. Y. Central Ry.) did not think the designs for the box or the gages were in shape to be adopted, as the brass comes within 1-16-in. of the end of the box, with the result that the end of the box may be broken out by the play of the axle. He also thought the gages for the bearing and wedge should be made more complete, and a gage for the box added. After some discussion, it was decided to refer the matter to the Committee on Subjects. The next report was that of the Committee on

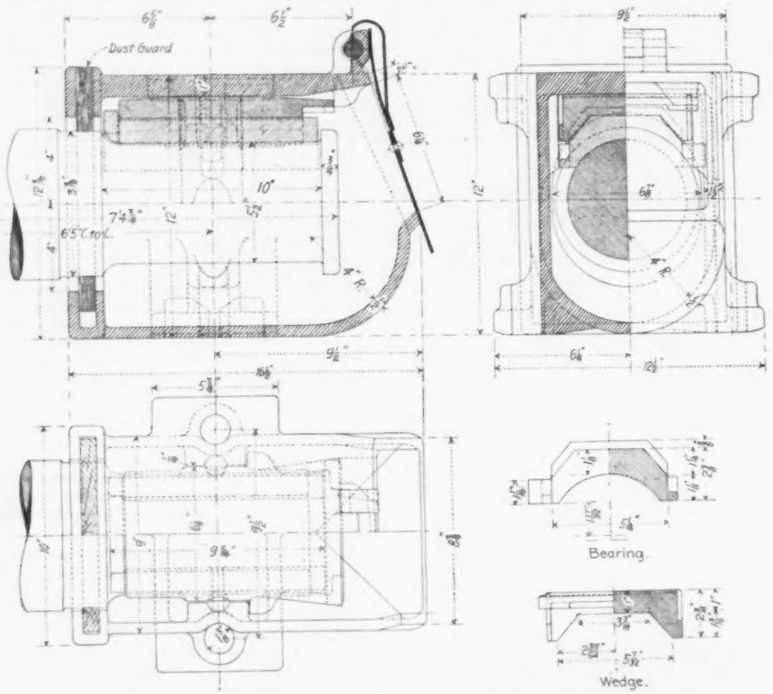


FIG. 2.—PROPOSED JOURNAL BOX FOR JOURNALS 5½ × 10 INS.

Revision of Rules for Loading Long Materials.

The alterations are mainly in the way of additions to make the rules more complete, including rules for the loading of stone, ties and tan-bark on open cars. There was very little discussion, and the report will be submitted to letter ballot as "recommended practice" of the association.

Revision of Passenger Car Rules of Interchange.

The report of this committee, submitting an entirely new set of rules, as already noted, was again taken up for final action. A motion to adopt the rules was voted down, so that the present rules will continue in force, but the Committee on Subjects was authorized to appoint a new committee to consider the revision of these rules. It was voted, however, on motion of Mr. Waitt, to modify the prices for materials on the basis of the new prices adopted for the freight car rules.

Recommended Practice, Including Designs for Springs for 100,000-lb. Cars.

A letter from Mr. R. P. C. Sanderson, Chairman of the Committee, was read stating that the springs have been in use too short a time for any results to be reported, and asking for an extension of time, which was granted.

Center Plates and Side Bearings for Freight Cars.

These two reports were taken up together, and were published in abstract in our last issue. The former made no recommendation, owing to the variety of designs submitted. The latter stated that as to anti-friction side bearings the rollers soon became flattened, after which the bearings are no better than the ordinary style. This statement did not meet with approval, and in fact one member of the committee, Mr. Pflager (Pullman Car Co.), stated that of 2,000 cars equipped with roller bearings, the rollers were perfectly round after three year's service. The old style of bearing with a single roller did flatten, but this does not occur with bearings having a number of small rollers. Other members spoke to the same effect, and it was decided to refer the report back to the committee for further consideration. It was also decided that the committee should report on both center plates and side bearings, as these are so closely related. The next report was that of the Committee on

Draft Gear.

This consisted mainly of a summary of replies to a circular of enquiry, but concluded with certain recommendations, which are given below. No. 1 is made by all the committee; No. 2-A is made by Mr. James Macbeth and Mr. W. E. Sharp, while No. 2-B is made by Mr. John R. Slack, chairman, as they could not agree on this.

(1) The ordinary type of draw gear known as the M. C. B. Recommended Practice is deficient in strength both in method of attachment to draw timbers and in capacity of spring. The strains imposed upon this both in pulling and buffing by heavy freight locomotives cause frequent failures and make it an expensive draft gear to maintain.

(2-A) A form of draft gear with metallic draft beams and twin springs, with draft rods running to needle beams, is the most desirable. Malleable iron is the best material for the draft beams. Buffing timbers should be protected with suitable malleable-iron draft caps. The use of the twin springs is desirable, as it maintains the present standard yoke for coupler.

(2-B) Tandem springs should be used and arranged so as to bring them both in action in pulling and buffing. The tandem spring appears to be preferable to the twin springs side by side, as the draft arms can be brought closer together, which makes a better construction, and does not require the use of such long follower plates as the twin springs. The springs used should be the same as the M. C. B. standard, 6¼ × 8 ins.

The committee would suggest that it might be desirable to make some tests to determine how much of the shock, especially of buffing strains, is absorbed by the two-coil spring, and also by the tandem spring, and what is the efficiency of the various methods of attachment to the draw timbers.

Mr. Bush (C., M. & St. P. Ry.) considered it safe to say that 30% of all cars that go to the repair tracks require to have repairs made to some part of the draft appliances. The capacity of the present draft spring is 19,000 lbs., but many freight locomotives exert a tractive power of 30,000 lbs., so that the draft springs of the train are solid when the engine is working at its maximum power. The capacity of the present gear is therefore evidently insufficient. He suggested that the committee should investigate the Westinghouse friction draft-gear. Other suggestions were made regarding the work of the committee: Mr. Delano (C., B. & Q. R. R.), by equipping tenders with the draft gears mentioned in the report, the results can be obtained much sooner than if cars only are equipped; Mr. Stark (C., L. & W. Ry.), draft rigging for steel cars should receive special attention; Mr. Marshall (L. S. & M. S. Ry.), it might be practicable to strike out on a new line and instead of modifying existing arrangements, to adopt a new design, with the idea of establishing a standard. The committee was enlarged, to consist of five, instead of three members, and the question of making tests, as recommended by the committee, was referred to the Executive Committee.

Uniform Section of Car Siding and Flooring.

This committee asked for an extension of time for one year, which was granted. A similar request was made by and granted to the Committee on

Metal Dead Blocks and Safety Chains.

Mr. W. P. Appleyard (N. Y., N. H. & H. R. R.) explained that the extension was asked for on account of the present conflicting opinions on the subject. Mr. M. Waitt then presented the report of the Committee.

Air-Brake Appliances and Specifications for Air-Brake Hose.

Answers to a circular of inquiry regarding the suggested additional standards for air-brake appliances, slack adjusters, additional air-brake power upon heavy capacity cars and in connection with specifications for air-brake hose, show apparently that very little vital interest is taken in this subject at the present time. Those in charge of motive power and car departments should see that employees who have to do with the repairs, maintenance and adjustment of air brakes on cars give more attention to the importance of a correct piston travel in order to have the brakes operate as nearly as possible at their point of maximum efficiency.

There is great neglect regarding the proper care of air-brake cylinders on freight cars. Many seem to think it simply necessary to remove the oil plug in the cylinders and put in a quantity of inferior-grade oil, leaving the packing leathers oftentimes hard and badly cut or worn. Experience seems to show that a light grease is more advantageous to use than a heavy oil, and it has also been found desirable to have the cylinders made without any oil hole, thereby making it necessary, whenever the cylinder is to be oiled, to take off the cylinder head, and so that at the same time the lubricating is done the packing leather and rings and the inside of the cylinder will receive proper attention in the way of cleaning, and any other necessary repairs required.

More attention should be given to reducing the number of elbows that are found in the piping of many cars. Every sharp bend in the pipe means a retarding of the action of the brake and added friction in the movement of the air through the pipes. As far as possible, in designing air-brake piping for cars, "ells" should be eliminated and long, easy bends substituted.

There was no discussion, and the report was received and the committee discharged. The next report was that of the Committee on

Tests of M. C. B. Couplers.

The work of this committee has been largely that of perfecting the details of the work submitted at the last convention, and no tests have been made. The drop-testing machine (Fig. 3) has been developed, and detail drawings accompanied the report, while an offer made by Purdue University to instal such a machine has been accepted. The gages for worn couplers and coupler contours are now being made by the Pratt & Whitney Co., of Hartford, Conn. The twist gage has not been put in the hands of a manufacturer, as there is a possibility of further change being made. The committee recommended that as couplers are now being bought on time specifications, they should be date marked in the same way as brake hose are now marked. There was little discussion, but on motion of Mr. Waitt, it was resolved that the railways should be notified when tests are to be made, and invited to send couplers for test. Only such couplers will be tested, and at the expense of the association. The report of the Committee on Subjects was then presented, suggesting subjects for committee reports for the next convention, in addition to the subjects already referred to the Executive Committee.

The President announced that the Executive Committee had decided to confer the honor of life membership upon certain members who have been active members for 20 or 25 years, an action which was warmly applauded. The members named are as follows: M. C. Andrews, R. C. Blackall, F. O. Bray, G. W. Demarest, James Denver, M. N. Forney, Wm. McWood, Robert Miller, Joseph Townsend, H. A. Webster and Benjamin Welch.

Safety Chains on Freight Cars Carrying Double Loads.

This topical discussion was opened by a written statement from Mr. R. P. C. Sanderson, who referred to the troubles arising from the interchange of chains. On his road, the plan has been adopted of using their own chains, removing them from cars going to foreign roads and placing them on cars received from such roads. Even when the drawbars are chained together, there will be some movement in the drawbar. He did not approve of putting on permanent check chains, but other speakers thought that all flat and gondola cars should be fitted with such chains, which would also serve to prevent accidents due to trains parting. Mr. Delano stated that on the C., B. & Q. R. R. the use of chains between cars loaded with long material, bridge girders, etc., has been dispensed with, and no accidents have resulted from this practice.

Wrecking Chains.

In some brief remarks on this topical discussion, Mr. Waitt favored the adoption of a standard chain. At present

many chains ... too weak for the purpose, and roads ... do not let them go to foreign roads, ... having ⅞-in. chains replaced by ⅝-in. ... standard chain would be interchangea- ... itating removal from cars.

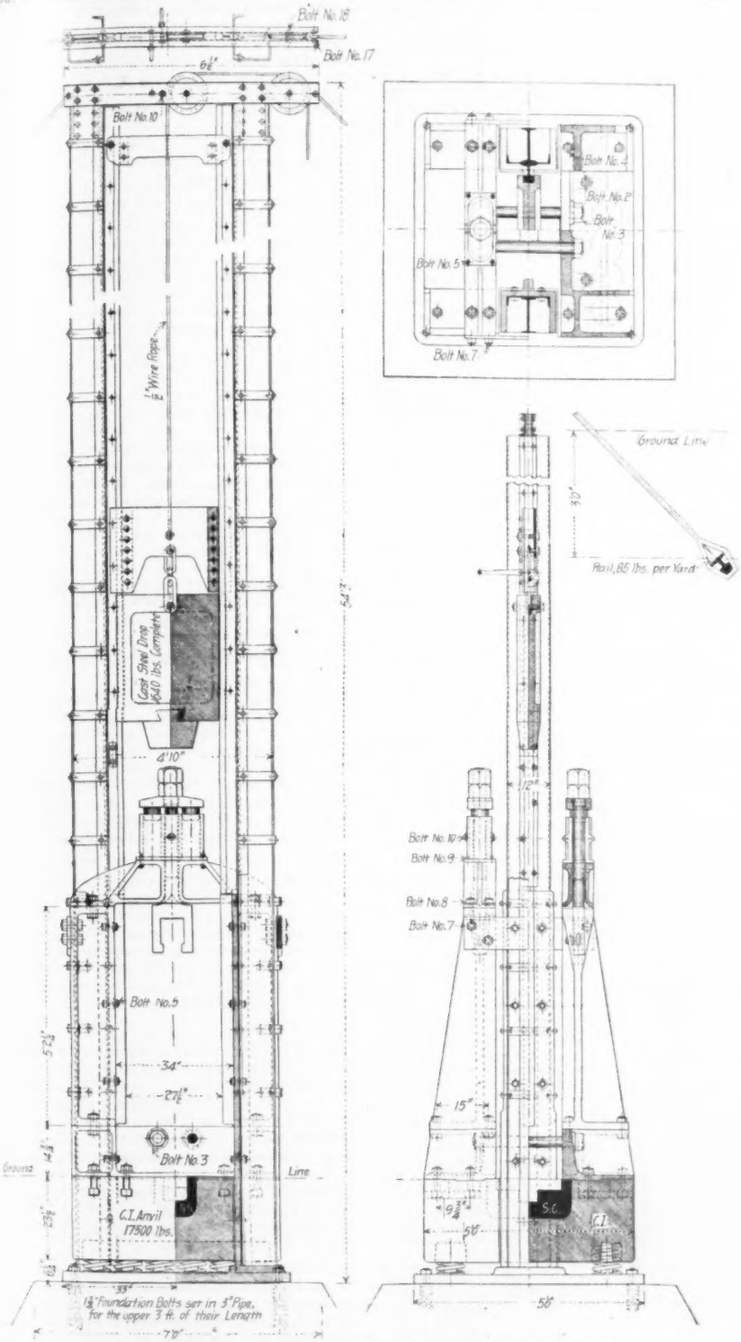


FIG. 3.—DROP TEST MACHINE FOR M. C. B. COUPLERS.

Cleaning Passenger Cars.

In this topical discussion, Mr. A. M. Waitt stated that he had found very good results to follow the use of dry wiping, as water is very injurious to varnish. When cleaning compositions are used, a certain amount of oil in the composition will give a polish and increase the life of the varnish, but oils which form a skin on the surface are not suitable. Mr. Morris (C. & O. Ry.) thought that while dry wiping might do for dark colors, it would not be satisfactory for light cars on a road where bituminous coal is used and there are many tunnels.

Trueing of Tapered Journals.

A few remarks on the question of making a charge against the car owner for repairs on account of trueing tapered journals were made by Mr. Rhodes, after which a general resolution of thanks to the railways, the local representatives, the supply men, etc., was presented and adopted. The officers for the ensuing year were then elected, as follows:

President, J. T. Chamberlain (Bos. & Me. R. R.); First Vice-President, J. J. Hennessey (C., M. & St. P. Ry.); Second Vice-President, J. W. Marden (Fitchburg R. R.); Third Vice-President, F. W. Brazier (N. Y. Central R. R.); Treasurer, John Kirby (L. S. & M. S. Ry.); Executive Committee, E. D. Bronner, J. H. McConnell and William Apps. This committee subsequently reappointed Mr. J. W. Taylor as Secretary

ANNUAL CONVENTION OF THE AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.

The 33d annual convention was held at Saratoga, N. Y., June 21 to 23, following immediately after that of the Master Car Builders' Association, reported elsewhere in this issue, and being attended to a large extent by the same representatives of the railway mechanical departments. The first meeting was called to order at 10 a. m., June 21, by the President, Mr. J. H. McConnell (Union Pacific Ry.), and was opened with prayer by the Rev. Delos Jump, of the Methodist Episcopal Church. An address of welcome was then delivered by Mr. A. J. Pitkin, Vice-President of the Schenectady Locomotive Works. The president in his annual address referred to the remarkably favorable industrial condition of the country during the past year, to the development in locomotive construction, and to the improvements in shop practice:

During the year 1899, there were 2,196 locomotives built in the United States, 1,716 for home roads and 480 (or 21.4%) for export; of the total number, 330 were compounds. The use of cast steel is increasing very largely, for frames, driving-wheel centers, driving boxes, cylinder heads, etc. Nickel steel is being slowly introduced for driving axles, crank pins and piston rods. The use of piston valves has also increased. In shop practice, the air compressor is now as important as the stationary steam engine, and air is used very extensively for operating hoists and portable tools. For driving machinery, electricity is more economical and is superior to line shafting driven by an engine. For small tools, compressed air is better and more economical than electricity. Tender tanks of 5,000 to 7,000 gallons capacity are now being built, and the weight on the driving wheels of passenger engines has reached 94,000 lbs. for eight-wheel and 130,000 lbs. for ten-wheel engines. The year has been one of large locomotives, and has produced four particular types, as follows:

Weight of engine, lbs.	218,000	225,000	230,000	232,000
On drivers, lbs.	193,000	198,000	202,000	208,000
Heating surface, sq. ft.	3,203	3,322	3,500	4,105
Cylinders, ins.	23 × 32	23 × 30	23 × 30	18 & 30×30

The report of the Secretary, Mr. J. W. Taylor, showed that the membership now comprises 620 active members, 19 associate members and 26 honorary members; or 665 in all. Of the association's scholarships at the Stevens Institute of Technology, one will be vacant in September; no candidate appeared for the June examination. The treasurer, Mr. Geo. W. West (N. Y., O. & W. Ry.), showed a balance in hand of $3,469. It was announced that the annual dues would be $5, as before. More than an hour was then lost in the discussion of a proposition regarding the election of certain gentlemen as honorary members, and the protests against this led to a decision to make certain changes in the constitution. This little bit of bickering seemed to disturb the harmony, and the subsequent technical proceedings of the session fell rather flat.

What Can the Master Mechanics' Association do to Increase its Usefulness.

In presenting this report, Mr. T. R. Brown (Penn. R. R.) stated that the committee had corresponded with general managers and superintendents, and found that it was considered that the association confined itself too closely to questions relating to the design and construction of the locomotive. There is a wide field for its work in regard to shop and equipment for the maintenance of the locomotive. A series of suggestions was made, and the conclusions of the report were adopted, as follows, the statement being made that the cost of the index is estimated at $500:

(1) That a committee be appointed to consider the suggestions made in the report, and present later in the convention recommendations for such changes in the constitution as may be necessary to carry them into effect.

(2) That a committee be appointed to act in the preparation of a complete printed index of the proceedings, from the first volume to date.

In the discussion the report was generally approved, and Mr. Deems (C., B. & Q. R. R.) advocated steps to obtain written discussions in advance, and the President, Mr. McConnell, pointed out that while the members freely discuss subjects at the meetings of the railway clubs, they seem to have very little to say at the conventions of the association.

Nickel Steel as a Journal Bearing.

A brief discussion on this topic was opened by Mr. W. H. Lewis (Norf. & West. Ry.), who considered such steel suitable. Mr. Vauclain (Baldwin Locomotive Works) saw no reason why it should not be used, provided that users are prepared to pay the extra price for steel of suitable quality. One member, however, thought nickel steel axles were liable to hot boxes, but another is using them on the engines of heavy fast passenger trains with success.

The Extent to Which the Recommendations of the Association Have Been Put in Practice.

The total number of circulars of enquiry sent out was about 600. The total number of individuals making replies was 23, the number of different railroads represented in the replies was 21, and the number of locomotives owned by the roads represented in the replies was 6,347. The number of locomotive builders represented in the replies was 1, and the number of mechanical engineers and others not in railway business making replies was 1. Your committee does not feel that from so small a number of answers out of so large a membership it would be proper to draw final or affirmative conclusions, but certain negative conclusions can at least be drawn. It is found that the recommendations of the association have been unanimously approved by those answering this circular in only seven cases. They have been approved with a small minority against it in 27 cases. They have been disapproved by a large minority, and in some cases even a large majority in 32 cases, while in the remaining twelve cases the opinion is too varied to classify. F. A. Delano, A. Sinclair, H. Middleton.

Appended to the report was a summary of the action taken by the association on various subjects, and an abstract of this we shall give later, as it is useful for ref-

erence. There was no discussion, and the committee was discharged, with thanks.

Relative Merits of Cast-Iron and Steel-Tired Wheels.

The only report giving data has been received from the Union Pacific R. R., in which they state that the average cost of mileage of 33-in. cast-iron freight car wheels is 8 cts. per 1,000 miles; the average cost of steel-tired wheels is 45 cts. per 1,000 miles. Mr. G. W. Rhodes, of the Burlington & Missouri River R. R., is of the opinion that 33-in. cast-iron wheels made to the M. C. B. standard test is a safer wheel than some of the steel-tired wheels on the market.

Under these circumstances, your committee is unable to add anything additional to the report printed in last year's proceedings. J. N. Barr, A. M. Waitt, H. S. Hayward, A. L. Humphrey, John Hickey.

Mr. G. W. Rhodes (C., B. & Q. R. R.)—Some members may wonder why I have so much confidence in cast-iron wheels. One of the dangers in cast-iron wheels is the application of the brakeshoes to the wheels and the heating of the surface of the tread, causing the plate to crack and the wheels to burst. The M. C. B. Association, however, has adopted specifications and requirements which almost entirely do away with this danger of breakages. When the thermal test of the M. C. B. Association was first adopted the manufacturers objected to it, and when we subjected the wheels to the thermal test we found they would not meet the requirements. But in the western country, where the wheels are operated in the mountainous districts, although we did not require any thermal test, we found that the foundrymen in those locations made wheels which stood the test. The explanation was reasonable and interesting. A foundryman said to me: "In this part of the country where shoes are applied so much with air brakes, we could not sell wheels if they did not stand heating from the service in applying the shoes."

That showed that actual practice had made the foundries in the West produce wheels more susceptible of severe braking application than was found in the East. Since the more general introduction of air brakes, and the fact that air brakes are being used as generally on cars on level prairie lines as in the mountain districts, our associations has emphasized the necessity for this thermal test. We have been buying wheels for the last two years under the thermal test; and I cannot find a broken cast-iron wheel, which has been cast in the last two years, that has been bought by the Burlington road. It is largely on account of that fact that I express myself so strongly.

Cast-iron wheels will crack in the plate and will break if they are not detected and removed. With some of the wheels with steel tires applied we have the same thing occur. The spokes will crack, and if they are not detected and removed, the wheels will break. The tires will also crack and break. That is the reason I gave the opinion mentioned in the report.

The next report was that on ton-mile statistics, dealing with a much disputed question, and, in fact, one member of the committee did not agree with the report and did not sign it. The results of the committee's enquiry may be summarized as follows:

Ton-Mile Basis for Motive Power Statistics.

Replies to our circular letter were received from 14 roads using the ton-mile basis for their motive-power statistics. The operating departments of 13 of these used the ton-mile basis for their statistics. The ton-mileage is compiled from the conductors' reports, usually in the Car Accountant's office, though there are 2 roads on which the work is done in the office of the Superintendent of Motive Power, 1 where the Auditor is in charge of it, and 1 where it is worked up by the Store Department. On 5 roads the net tonnage, or that in the cars, is kept separate from the gross, while on 9 it is not so separated. There are 8 roads which do not include the tonnage of the engine in their ton-mileage and 5 which do; 4 do not include the way-car and 9 do.

East and west bound ton-mileage is kept separately by 8 roads and is not so kept by six. All the roads reporting use the ton-mile basis for freight service; 9 for passenger and freight; and 3 for passenger, freight, work and switch engines.

None of the roads in their ton-mileage add a per cent to the weight of empty or partially loaded cars to account for the additional power required to haul a ton of these as compared with fully loaded cars, though a number of them add it to their tonnage ratings. It is difficult to surely say from their answers whether any make a practice of determining the actual weights of their cars and their contents except from the way-bills and stenciled weights, but it is evident that a number weigh the loaded cars where practicable. On 11 roads, the statistics for the main line and branches are shown separately. Of the 9 roads which keep their passenger service statistics on the ton-mile basis, 7 add nothing to the weight of the cars for passenger baggage, express or mail, while 2 do. One adds to the scale weight of their coaches, chair cars and sleepers, 2 tons; to that of their baggage and mail cars 5 tons for their contents. Another adds 3 tons to all their cars in passenger service.

This report called out quite a brisk discussion, mainly in the line of advocating further investigation and research, as the subject is one of importance, and after this discussion the meeting adjourned.

In the evening there was a vaudeville entertainment at the Saratoga Theatre.

On Friday, the first subject taken up was the report of the Committee on "Flanged Tires," and this was followed by the report of the Committee on "Compound Locomotives." Abstracts of these papers, with the discussions, will be given in a later issue, as both subjects were of special importance and well handled.

The Limit of Length of 2-in. Tubes.

The topical discussion on this subject was opened by Mr. Vauclain, who thought that the limit had not been reached. In this country the maximum length is 16 ft. (for some engines on the C., B. & Q. R. R.) and 16 ft. 7¾ ins. Abroad, lengths of 17 ft. 5 ins. and 18 ft. 1 in., have been tried with success. A length of 20 ft. is entirely practicable, but in hauling dead engines with such tubes the boiler ought to be filled with water to prevent the vibration, which might otherwise loosen the tubes in the tube sheets.

Metal and Wooden Cabs.

Mr. Sague (Schenectady Locomotive Works) stated that steel cabs are much less costly to keep in repair, but they cost about $100 more and weigh more, this latter feature being sometimes serious for engines in which the weight of all parts must be kept at a minimum. Mr. Wm. McIntosh (C. R. R. of N. J.) is using light cabs with a combination of steel and wood, and steel and wood pulp, and Mr. Robert Quayle (C. & N. W. Ry.) is considering the adoption of the steel cab.

The report of the committee appointed to consider proposed changes in the constitution was then read, after which the meeting adjourned. At 1 p. m. a special train carried a large party to Schenectady to visit the Schenectady Locomotive Works, where luncheon was provided, after which ample time was given for the visitors to examine the works, the train leaving on the return trip at 5 p. m. In the evening there was the annual ball of the association.

On Saturday the meeting opened at 9 a. m., and the first proceeding was the presentation of the report of the Committee on

Journal Bearings, Cylinder Metals and Lubrication.

This report gave a number of the mixtures adopted by various railways for their cylinder castings, showing that some roads now use a certain amount of steel turnings or cullings in the mixture; New York Central Ry., 5%; Southern Ry. and Wabash Ry., 15%; Chicago & Northwestern Ry., 20%. Most roads favor casting the cylinders with the saddles, and also favor the use of solid piston heads rather than heads of the spider and bull ring type. From the list of alloys for bearing metals on heavy and fast engines, we take the following, and most roads also use soft metal in connection with bearing metals:

C., B. & Q., copper, 77 to 81%; tin and lead, 9 to 11%, each; phosphorous, 0.7 to 1%.
Southern, copper, 100 lbs.; tin, 14 lbs.; zinc, 2 lbs.; ferro manganese, 2 lbs.
Erie, copper, 76.45 parts; tin, 11.77 parts; lead, 11.78 parts.
Wabash, copper, 8; tin, 1; lead, 1.
C., R. I. & P., copper, 78; tin, 16; lead, 6.

Several roads report difficulty in the lubrication of slide valves on engines carrying 200 lbs. pressure, but the committee believes that with modern lubricators and proper lubricants very little difficulty should be experienced in the oiling of valves and pistons.

In the discussion Mr. Clamer (Ajax Metal Co.) explained the requirements for bearing metals. Mr. F. A. Delano (C., B. & Q. R. R.) stated that many roads are using hard metal bearings in which most of the wear is taken by a lead lining, the brass being rebored and relined when the lead is worn, so that they are practically soft metal bearings. He did not approve of the use of lead in this way, but favored a filled brass. Mr. F. M. Whyte (N. Y. Central) thought that while the cylinder and saddle should be cast together, the cylinder should be bushed with hard metal and the valve seat also fitted with a false seat of similar metal.

Piston Valves.

For steam pressures exceeding 185 lbs. the piston valve offers considerably less resistance than the slide valve, thus reducing the work the entire valve-gear must perform and reduces the internal resistance of the locomotive, which is thought to be considerable in modern high-pressure engines. For such pressures the question of valve lubrication is very much simplified and the difficulties of cut valves and seats are very much diminished. The cost of maintenance seems to be no greater than with the slide valve. This statement is not based on a large number of figures, but rather on the judgment of those using the piston valve.

The area of admission and exit openings can be very materially increased with the piston valves, which, with higher power locomotives, seems to be a very important advantage, and it is well known that, in order to obtain the highest efficiency from a locomotive, it is not only necessary to get the steam into the cylinder promptly, but to get it out again. The committee believes that, in adapting the piston valve to the simple engine, the internal admission type has possibly a slight advantage in that the loss of heat of steam going into the cylinders is somewhat less than in the case of the external admission type.

Some railways and locomotive builders, when designing valve gear for piston valves having internal admission, assume that the valve gear as designed for external admission would answer for those with internal admission. Practice develops that this is a mistake, and that in order to obtain the proper steam distribution, the valve gear must be specially designed for the internal admission. In designing the piston valve attention is called to the necessity of obtaining the benefit of all the area of admission and exhaust which the principle of the piston valve affords. This has not always been taken advantage of to the full extent.

One point in piston-valve construction that has been found to have a material effect on steam distribution has been somewhat overlooked, namely, the difference in area between the forward and rear end, the area of the rear end being reduced by the area of the piston rod; the two ends are therefore out of balance, and as a result the motion of the valve in one direction is deranged as compared with the motion in the other direction, inasmuch as the lost motion in the valve gear is taken up in an opposite direction from that which is ordinarily the case. This is based upon experiment on the part of the committee, and from the statement of an individual to the effect that a locomotive equipped with piston valves ran for quite a distance with one of the valve stems broken, the valve making its regular movement by being pushed ahead by the end of the broken valve-stem in one direction, and pushed back again in the opposite direction by the excess pressure on the forward end of the valve. The committee finds a great variety of packing used for piston valves. It can be said, however, with perfect certainty that plain snap packing rings will give entirely satisfactory [illegible] Bush, Wm. McIntosh, H. Schlacks.

Mr. F. A. Delano stated that the C., B. & [illegible] about 65 simple engines with piston valves [illegible] steam on the inside. Prof. W. F. M. Goss [illegible] object sought in reducing valve friction is [illegible] reduce the internal friction of the engine [illegible] valve represents only a small proportion [illegible] ensure a better steam distribution, as this [illegible] fected by valve friction. Mr. G. R. Henderson [illegible] Ry.) stated that piston valves are used to [illegible] his road, and on the N. & W. R. R.; they [illegible] handle, and there is no trouble with the [illegible] favored a plain snap packing ring, as [illegible] Other members also spoke favorably of pist[illegible] their personal experience

Power Transmission by Shafting vs. Electricity.

This report was of exceptional interest [illegible] broad way in which the subject was treated [illegible] the matters of detail which are often deal[illegible] reports and make them more or less biased [illegible] was commented upon in the discussion. W[illegible] abstract of the report in a future issue. Mr. [illegible] Q. R. R.) referred specially to the advantag[illegible] ing belts, so that cranes can be used to bet[illegible] Mr. Gillis (Richmond Locomotive & Machine W[illegible] that electric power is to be introduced thr[illegible] works. The 25 or 30 motors now used are [illegible] type, and have been in use from six months [illegible] have as yet cost nothing for repairs. Another [illegible] is that the machines can be located in any desired position, regardless of any shafting. Mr. Geo. Gibbs (Baldwin Locomotive Works) thought the 220-volt motor the best, as while the 500-volt machine saves something in wires, it is too dangerous for use in shops. Mr. Rohrer (General Electric Co.) pointed out that with electric transmission it is possible to increase the cutting speed of tools to the maximum. The Schenectady shops are operated on a 250-volt three-wire system, direct-current motors being used partly because they are easier to control, and partly because their use was commenced before the alternating motors were introduced.

Best Type of Stationary Boilers for Shop Use.

Of this report also we shall give an abstract, but its most important feature was the recommendation of a more general use of superheating arrangements, though the plan proposed did not meet with the approval of those taking part in the discussion. Professor Goss noted the use of superheating on a German locomotive, a 14-in. tube containing the apparatus. This tube took the place of a group of the ordinary tubes. The steam economy was almost equal to that of compound engines, but this was more than balanced by the increased cost of repairs.

How to Make Pooling Locomotives a Success.

This topical discussion was opened by Mr. G. W. Rhodes, who pointed out that care must be taken to have the engines worked in a pool given as much attention as those which receive the personal attention of one set of men, because in a pool the repairs and cleaning are not looked after very closely by the engineman and fireman. On one division, he has 52 crews in a regular pool, operating 37 engines. Mr. Henderson (C. & N. W. Ry.) thought it better economy to have 50 engines worked to their full capacity and worn out in 10 years, than to have 100 engines, making less mileage and lasting for 20 years. The 50 new engines required in 10 years would be considerably improved upon the first lot. Mr. H. T. Bentley (C. & N. W. Ry.) preferred two engines and three crews, the third acting as a swing or extra crew. Under this plan, some of the freight engines make 202 miles per day, while a passenger engine in similar service makes 404 miles per day throughout the month. Mr. Brown (Buff. & Sus.) believed in double crewing, but not in pooling, as more work is then done by the crew and sufficient mileage is got out of the engines. Under this system he has engines making 240 and 290 miles per day.

Graphite as a Locomotive Lubricant.

This topical discussion was opened by Mr. G. R. Henderson (C. & N. W. Ry.), who discussed the use of graphite on journals. He had tried it, but without much success, owing to the difficulty of getting it properly applied. Flake graphite was first sprinkled on the waste in the back of the collar, but the journal would wipe some of it off and this would form a crust on the waste. About 10 to 15% of graphite was then mixed with oil, and made into a sort of dope with waste, which was only partly successful, and the use of plugs of graphite inserted in the bearings has not given very good results.

The committee on resolutions then presented a comprehensive resolution of thanks to the entertainers and others. The last proceeding, before final adjournment was the election of officers for the ensuing year, the election being by ballot, and resulting as follows: President, W. S. Morris, C. & O. Ry.; First Vice-President, A. M. Waitt, N. Y. Central R. R.; Second Vice-President, J. N. Barr, B. & O. R. R.; Third Vice-President, G. W. West, N. Y., O. & W. Ry.; Treasurer, A. Sinclair.

There was a very large and interesting exhibit of railway material and appliances, and a full list of the exhibitors will be found in our Supplement.